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SCIENTIFIC AND UNSCIENTIFIC APPRENTICESHIP.

AN important paper has recently been read by Professor Sylvanus Thompson, before the Society of Arts, on "Apprenticeship: Scientific and Unscientific." The subject is, at the present time, one of the highest interest, and following so recently as it does upon Professor Ayrton's paper on "Technical Education," it cannot fail to be of very considerable weight. That a certain amount of training is given under the present system of apprenticeship Professor Thompson does not deny, and indeed it must be evident that he cannot do so; but the amount of information and practical knowledge which the apprentice may pick up is very far short of what should be the case, considering the lengthened period during which he is practically under rulers and governors. This, as Professor Thompson points out, is due to the utter want of system at present pursued in the training of apprentices. As is truly pointed out—

"Since apprenticeship is a process of learning something, it is clearly, like every other process of learning, subject to definite principles or general laws. Just as there is a right way and a wrong way of learning to read, or to cipher, or to write, so there is a right way and a wrong way of learning a trade or an art, a handicraft or a profession. Unfortunately," continues the Professor, "although in each case this observation may at first sight appear to be a truism, it is strange how far the majority of mankind are from believing that there is a genuine science of education, the general principles of which are equally applicable not only to the processes of learning how to read, to cipher, and to write, but also to those of learning how to build houses, to print books, to construct machinery, to compound drugs, or to mould porcelain or glass."

A system of training exists in many professions, and, as is pointed out, in none is this principle carried to such an extent as it is in the profession of medicine and surgery, a natural consequence, perhaps, of the vital importance of the subject; since our very existence is practically more dependent upon a thorough knowledge of the healing art than upon anything else. But if a system is necessary for a thorough knowledge of the profession referred to, it is a logical consequence that the converse is the case, viz., that to obtain a thorough knowledge of any trade or profession a systematic method of teaching it is highly necessary. Taking a supposititious case, Professor Thompson says:—

"Suppose we had the duty of training a youth for the medical profession, what kind of training should we give him to prepare him for his career? I presume we all know that no man can practice in this country as surgeon or physician without a diploma or licence, and that such a diploma or licence is only granted to those who have been for several years pursuing a course of studies in the theory and practice of their future profession, and have attained to a certain degree of proficiency, as attested by the certificates they produce from one or other of the various recognised medical schools.

"Suppose, however, that leaving the accepted routine of lecture-going, reading, dissecting, and hospital practice, prescribed in the schools of medicine for our young aspirant, we were to adopt the following course:—Keep the youth for five years studying metaphysic and dialectic; then, at the end of this period, send him straight to work amputating and drugging, under the directions of an overlooker, whose best qualification was that he could drive the young student through the greatest amount of paying work in the shortest possible time. Suppose, moreover, all theoretical instruction, all access to books, to be carefully eliminated, and that meantime he should be taught to laugh at and despise the notion that theoretical knowledge was of any service to him, even dissection for the sake of adding to his knowledge and experience being forbidden him as not being paying work. Suppose this to go on for seven long years, the only change in the routine being that towards the close of his time that he should no longer be required to perform such menial offices as washing floors or running errands. Suppose, I say, this course to be adopted and deliberately defended as a system of medical education, what would be thought of it?

"Yet, strange as it may seem, the outrageous course which we have allowed ourselves to suppose is a faithful analogue of that which in thousands and hundreds of thousands of cases is going on today, not in the apprenticeship to the medical profession, but in the apprenticeship to the handicraft trades. For the five years of metaphysics, read five years of purely literary study in the elementary school; and for seven years of unintelligent and uninstructed work, read seven years of unintelligent and uninstructed drudgery in a workshop, under an uneducated, unsystematic overlooker, selected for that post simply because he is a good slave-driver; and you have a not overdrawn picture of that which goes by the name of 'apprenticeship' in too many of the handicrafts of England."

This state of affairs, which is well pictured, has not always been the case, it is simply a consequence of the changed social habits of the nation; formerly the apprentice was, in the majority of cases, looked upon and treated almost as one of the family of his employer, and as such naturally took an interest in his work, now these relations no longer exist. The capitalist is essentially the employer, and an employer who deputes his manual work to an underling who practically can have no

interest in furthering the advance and imparting knowledge to the apprentice. How is the education of apprentices to be made to harmonise with the existing state of affairs, so that he may be able once more to have a fair chance of learning his craft in an intelligent and scientific manner? Professor Thompson points out the way in which this can be done, he says in answer to the question,

"What are the principles that must underlie the attempt to reconstruct in a manner adequate to modern, social, and industrial conditions, the rational scientific apprenticeship of the future?

"Those general principles may, I think," says the Professor, "be laid down without much difficulty: what difficulty exists will be found rather in the application of those principles than in their abstract enunciation.

"*Firstly*, in learning to perform any handicraft operation, or to use skilfully any tool or appliance, it is evident that the ability to do that one thing rapidly and well can only be acquired by practice; and that the beginner must learn by doing the thing many times over, slowly and carefully at first, rapidly and well afterwards.

"*Secondly*, where, as in the case of most skilled (and in many so-called unskilled) industries, the craftsman must know how to do a great many things, or to use many different tools, it is evident that the process of acquiring the complete knowledge of the craft will be much facilitated if the learner be not kept doing over again that which he already knows how to do rapidly and well. Having gained skill in one operation by doing it often enough to acquire speed and precision, he ought at once to set about mastering the difficulties of some other operation. If he is kept for months or years doing over and over again that which he already knows how to do rapidly and well, and is employed as a cheap machine simply to put money into his master's pocket, he is losing just so much time of his apprenticeship.

"*Thirdly*, all practical operations which have thus to be learned by repetition ought to be presented to the young apprentice in a graduated order best suited to his growing powers: the easy first, the harder as he gains power and knowledge. There is in every craft an order in which the round of skilled operations are best learned, an order not to be hastily settled, but known only to those who have themselves been trained and have had to train others, and is clearly an order in the course of which the learning to do one thing shall best prepare the way for the learning to do the next. The round of manual acquirements ought to be rationally and systematically arranged.

"*Fourthly*, no apprentice should be allowed to do anything without being shown or told how to do it. It is a point of the utmost importance that the young workman should never be allowed to work unintelligently; the habit of unintelligent working once acquired is hardly ever thrown off. The prevailing idea in this country seems to be that a man ought to learn how to do a thing by simply doing it; whereas the *rational plan is to ascertain first how it should be done, and then to do it.* There is always a best way of doing a thing, known only to men of intelligent practical experience. No work should be attempted by a beginner until the method and *rationale* of it has been explained to him. He will thus be saved from trying bad and useless methods, and will be called upon to use his reasoning faculties. There can be no question that theoretical knowledge may thus be of great service in saving a workman's time. This constitutes, indeed, the main difference in many trades between the practical training of English and Continental workmen. One is supposed to learn simply by doing the thing over and over again, blindly and unintelligently; the other is supposed to learn by first learning how the thing ought to be done, and then doing it.

"*Fifthly*, instruction in the general principles of science, which underlie almost all handicraft trades, ought to be taught systematically to the apprentice by teachers who understand what they are teaching, and who also are acquainted with the practical details of the applications of those principles to the particular trade followed by the apprentice, so that they may be able to point out continually the agreements and the apparent discrepancies between abstract theory and the actual methods of practice dictated by experience.

"*Sixthly*, instruction in manual exercises ought to begin early. The dexterity of hand, the quick perception of the eye, are not to be attained after a certain age. In many skilled crafts this age is indeed very early. Musicians know how early the child must begin to practise whose fingers are to acquire a perfect training, and there are many industries requiring a skill of hand little short of that which the violin player or pianist must possess.

"*Seventhly*, throughout the period of apprenticeship, but particularly in its early stages, the manual exercises set to the apprentice should be chosen solely because they will improve his growing capacities; the idea of making him do paying work ought to be set aside. The thought should be, not what will pay now, but what will pay twenty years hence. Therefore, every other consideration should be subordinated to the desire to improve the skill of the apprentice.

"*Eighthly*, to give breadth and generality to the practical knowledge of the apprentice, he should, in the early stages of his training, see something of various kinds of work; there being undoubted advantages in a carpenter, for example, and a smith knowing something of each other's work. Too early a specialisation cramps the powers alike of the hand and of the eye."

In our last number of the JOURNAL, in speaking of "Technical Education" we alluded to the well fitted educational establishments on the Continent, and Professor Thompson, in his paper, speaks with great interest of these schools, as fulfilling his idea to a great extent of what a place of the kind should be. He says:—

"I propose now to turn to some of those continental institutions in which it appears to me the principles laid down as those underlying a rational and scientific apprenticeship may be seen in operation.

"We are probably all aware of the innumerable and splendid technical schools and colleges which exist in Germany, Switzerland, France, Austria,

Belgium, and even in Russia. I will name as types of them the *Polytechnikums* of Dresden, Stutgardt, Berlin, and Zürich, the three *Ecoles des Arts et Métiers* of Aix, Angers, and Châlons, and the *Ecole Centrale des Arts et Manufactures* of Paris. These institutions do not profess to teach any trade or industry, except engineering, which in some of them is a special feature; they are colleges for applied science to which educated persons may resort to add to their technical knowledge. Hence, while admirable for giving to foremen, masters, and the professed teachers of applied science, the higher technical training those persons need, they do nothing directly for apprenticeship. Indirectly, however, they do a great deal in their respective countries for apprenticeship in the mechanical trades, inasmuch as they provide what in England we have no recognised means of providing—trained men as heads of workshops; men who are superior to rules of thumb, and who have some notion how to train the young beginners placed under their charge."

Of one of the "apprentice schools proper" the following interesting account is given :—

"The *Ecole d'Apprentis* of Paris, situated in the Boulevard de la Villette, is a school of similar character, but surpasses the Havre school in size, in the extent of its appliances, and in the general superiority of its organisation. The results attained by this school are truly striking. No pupil is admitted before thirteen, nor without his certificate of elementary education. The course of instruction lasts three years, about half the day being given to schooling, and half to practical work in one or other of the workshops. The lads, who go out at sixteen or seventeen, are able at once to rank as skilled workmen, earning a wage usually only obtained by those who have served a much longer apprenticeship in the shops, and in some cases to earn higher wages than the average skilled workman who is of age. Happily, the promoters of this school have viewed the experiment in a truly scientific spirit, and the exact date which they have kept upon all statistical matters enable a precise estimate to be drawn of the signal success attained by the school. The school was founded in 1873. Of 74 apprentices who had gone out up to August, 1877, 69 remained faithful up to the present year in the industry taught them in the school; and their average rate of payment on leaving had been equivalent to 18s. a week, reckoning 56 hours to the week's work; their average age on leaving being seventeen years and a half. Some of these, the young smiths and metal turners, earn more than this, and receive from 20s. up to 30s., and even 32s. a week, as soon as they go out to work. Now, this school is one where there is a graded series of manual exercises, where those exercises are undertaken solely to develop the pupil's skill without reference to their commercial profitableness, where no work may be attempted until the how and why have been explained, nor until the piece of work has been made the subject of a proper working drawing. It is a school where regular systematic, technical, and scientific principles are both instilled in class and insisted upon in the workshops. The instruction is not left to uninstructed workmen, but is in the hands of competent teachers, the head of the workshop staff, for example, being himself a former pupil of one of the *Ecoles des Arts et Métiers*, and thoroughly imbued with the scientific spirit, while the teacher of physics is an accomplished assistant in the Paris Observatory. The director, M. Müller, is himself animated with the spirit of the institution, and conducts excellent classes in descriptive geometry and other subjects. M. Bocquet, the superintendent of the workshops, gives a course of technological lessons, which, beginning with descriptions of tools and bits of machinery, bolts, nuts, keys, &c., leads up a complete knowledge of machinery and of machine tools. Drawing, applied physics, applied chemistry, algebra, arithmetic, geometry, and even industrial jurisprudence form parts of the curriculum of studies. To visit this school and its workshops—and I have visited it seven times, and spent many hours within its precincts—is sufficient to dispel the notion that the rational scientific apprenticeship advocated here, and in my pamphlet on 'Apprenticeship Schools,' is an impossible or Utopian idea, incapable of existing anywhere, except on paper. The problem is solved; and it is now simply a question of cost how far this solution can be applied."

No one reading this glowing account of the means of technical education existing abroad can help seeing how far we in England are behind hand; but where are the practical results we would ask? As we have before remarked, how is it that with such great educational advantages the foreigner has not ousted the Englishman and drawn away all his trade? It is true Professor Thompson points out a few cases where our trade is at a low ebb, but the latter we should imagine would be universal, and this is not so. By all means organise a system of schools having the foregoing objects in view, but ascertain first whether the entire system is founded on the best principles, and then go to work.

In concluding his paper Professor Thompson says :—

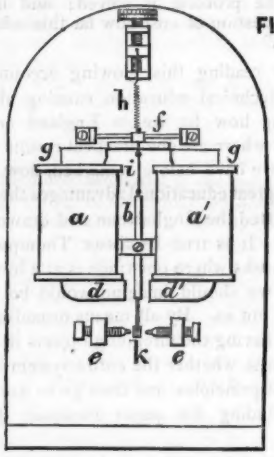
"There is no question whatever but that the persistent neglect of technical education in England will sooner or later ruin her in the markets of the world, which will be seized by less favoured but more highly trained nations. And the work of technical education is only half begun if it stops short of regenerating the education of the apprentice.

"The skilled industries of Great Britain, with their irregular bands of workers, trained anyhow, nohow, armed with fantastic scraps of empirical knowledge, and swaddled up in rules of thumb, are doomed before the industries of nations who bring into the field ordered legions of trained workers equipped with intellectual weapons, and clothed with sound science. Against such adversaries all the stores of coal and iron in our hills and valleys will be of little avail. We have, however, one chance left; we must adapt our systems to the new social order, and organise and drill and train our workers in a systematic and scientific apprenticeship, in accordance with the dictates of right reason, and in harmony with the spirit of the age."

BRIGHT'S IMPROVED RELAY.

THE object of this invention is to obtain great sensitiveness and certainty of action. In the ordinary relays in which a complete signal is made by a single current, the moving part is brought back to its place of rest or zero by a spring, or by one portion of the moving part being heavier than another, or by an electro-magnet being polarised by a permanent magnet. In these methods of controlling the moving parts of the apparatus, the magnitude of the signal given, or the force with which contact is made, when a local circuit is made by such moving part, represents only the difference between the power of the electrical current employed and the force of the controlling agent. In the improvement invented by Sir Charles Bright, the moving part of the receiving apparatus by which the signal is given or the contact is made, whether it be a magnet, a soft iron armature, or a coil of insulated wire, is controlled by a second moving part, which is worked

FIG. 1.



by the same current in such a manner as to withdraw all restraint from the first or signalling part while the current is passing, and to bring it back to zero and retain it there when no current is passing. Fig. 1 shows the front elevation of a relay constructed upon this system and adapted for making contact on either side, according as a positive or negative current is sent. a, a^1, are two electro-magnets fixed vertically on an upright frame which have opposite poles when a current is passed through them; b is a permanent magnet presenting one of its edges to view; it works upon a centre at c, and is influenced by the poles d, d^1, of the electro-magnets; e, e^1, are two insulated contact screws; f is a soft iron armature acted upon by g, g^1, the upper poles of the electro-magnets; h is an adjustable spring. b is joined to f by i, which is a hair, or thread, or piece of fine wire. When no current is passing, the spring h holds back the armature f as far as the connection of f with b by i will allow, and b is thus retained at zero, the contact piece k at its lower end being midway between e, e^1. Upon the passage of a current, whether positive or negative, the armature is attracted by g, g^1, its control over b by means of i ceases for the time, and b is free to move without any retarding force to either side, according to the direction of the current.

When a current of one kind only is used, as with the ordinary Morse alphabet, a soft iron armature may be advantageously used in place of a magnet. Fig. 2 shows a plan, and fig. 3 a front elevation of an instrument so constructed, the letters in the figs. referring to the same parts; a, a^1, are two electro-magnets fixed horizontally; b is a soft iron armature carried by a lever c working on its centre d. The armature b enters between the poles of the

FIG. 2.

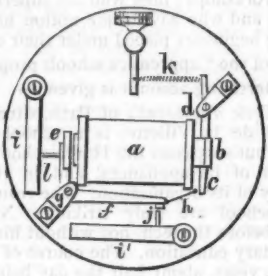
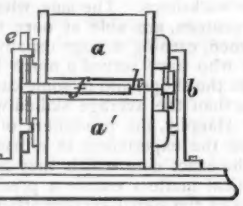


FIG. 3.



electro-magnets in the manner shown at f in fig. 1; e is an armature at the other end of the electro-magnets fixed to the lever f which works on its centre g; f is connected to c by the thread h; i, i^1, are two metallic reeds or sounders which are only shown in Fig. 2 with projecting pins j, j^1; they are insulated from each other, and by connecting g to one side of a local circuit and i^1 to the other, the signals may be read by sound and recorded at the same time; k is an adjustable spring by which, when no current is passing, b and c are drawn away from the poles of a, a^1, as far as is permitted by the connection h, the tension of which derived from the spring k, though c causes f, e, to press against j. Upon a current passing, the action of k upon h is withdrawn by the attraction of b to a, a^1, and h is moved against j by the attraction of e to a, a^1.

It is evident that the principle involved in the apparatus can also be applied to other telegraphic apparatus, and to the ordinary single needle instrument. In this case the front index needle of the instrument has simply to be attached to a prolongation of the axis of b.

THE GLASGOW ELECTRIC FIRE ALARM SYSTEM.

A SYSTEM of electric fire alarms has now been in use at Glasgow for some years, and has been very successful. The apparatus is very simple in construction, and little liable to get out of order. As the question of fire alarms is likely to receive more attention in this country than has hitherto been the case, a description of the Glasgow apparatus may prove interesting.

Fig. 1 shows the outward form of the signalling apparatus, which is placed at the corners of a number of the streets in the town. The arrangement

Fig. 2 shows an inside view of the wall-box. The upper part is occupied by batteries 18, placed on shelves as shown. In the lower part is fixed the push key 13 (which is shown on an enlarged scale by figs. 3 and 4) and the acknowledgment bell 21.

The push key 11 (fig. 4) is a tube having an annular head on its outer end, on which the word "push" is marked, and it is carried in a tubular bearing 12, fixed on a three-armed bracket 13. A helical spring is arranged inside the tubular bearing 12, to press the push key 11 outwards, and when the key is pushed inwards its inner end acts on a metal spring 14, and causes it to make a contact with a piece of metal 15, thereby closing the circuit

FIG. 3.

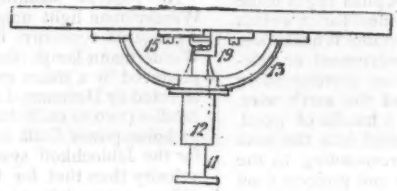


FIG. 1.

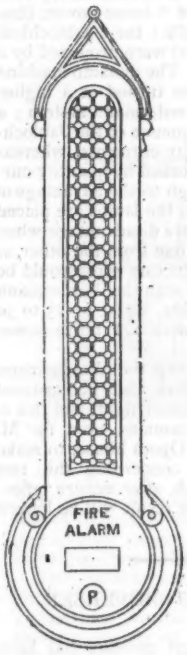


FIG. 4.

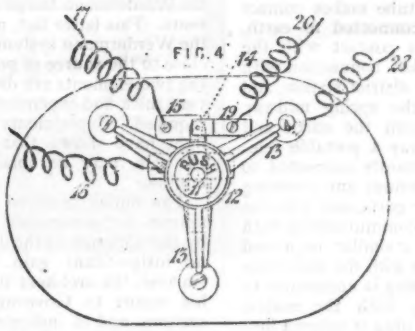


FIG. 2

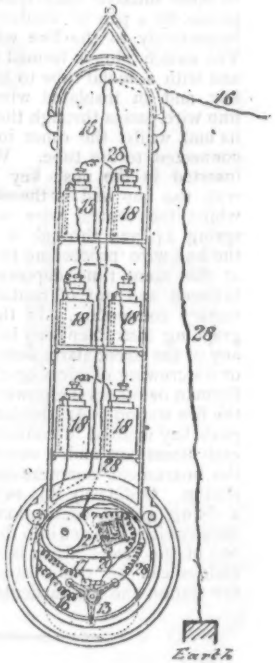
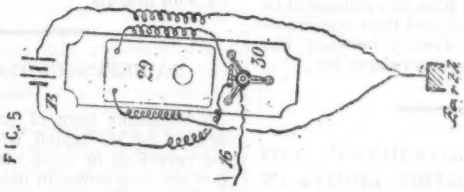


FIG. 5



consists of a cast iron box, about 4 feet high, placed sufficiently high up on the wall of the building to which it is fixed to be out of easy reach of loiterers, but yet sufficiently low to be got at with a little exertion. To sound an alarm it is only necessary to depress the push key P, when a bell is rung at the fire station with which the apparatus is in communication, and on the receipt of the signal at that place an acknowledgment signal is returned, which sounds a bell placed in the lower part of the case.

of the wire to the district station, and sounding the bell at that station. The spring 14 is connected to the line wire 16 (figs. 2 and 4), and the metallic piece 15, into contact with which the spring 14 is pushed by the key 11, is connected by a wire 17 to the battery 18, shown in fig. 2 as occupying the upper part of the fire-alarm box. When the spring arm or switch 14 is not pressed in, it forms a contact with a metallic piece 19, which is connected by a wire 20 with the electro-magnetic bell 21 in the

fire-alarm box, and this bell can consequently be sounded from the district station to show that the alarm signal has been noticed.

At the district station (fig. 5) there is provided for each street fire-alarm box that is in connection with the station an electric bell 29 and a push key 30, like those in the street fire-alarm boxes. The parts are arranged so that by simply pushing in the key 30 the battery B sends a current to line which causes the bell 21 at the street box to be sounded, thus acknowledging the receipt of the alarm.

Mr. R. S. Symington, of Glasgow, has recently patented an improvement in the apparatus, by which a portable A B C or other instrument can be very readily put in connection with the line, and thus a correspondence be carried on with the fire station. This addition to the apparatus is effected by means of an improved push key. This push key is made tubular to receive an improved connector or switch plug, which is connected to the portable Wheatstone, or other suitable telegraphing instrument or telephone, by a pair of insulated wires corresponding respectively to the line wire and the earth wire. The switch plug is formed with a handle of wood, and with a metal tube to be entered into the push key, and an insulated wire corresponding to the line wire passes through the tube and projects from its end, whilst the other insulated or earth wire is connected to the tube. When the switch plug is inserted in the push key its tube makes contact with the key and is thereby connected to earth, whilst the central wire makes contact with the spring 14, and through it makes connection with the line wire proceeding to the district station, and at the same time depresses the spring midway between and out of contact from the earth and battery connection. In this way a portable telegraphing instrument can be instantly connected to any of the street alarm boxes without any screwing or unscrewing of wires or other parts, and give the fireman or others the power of communicating with the fire station. At the latter a similar improved push key is fitted in connection with the wire from each street box, and a switch plug is connected to the instrument communicating with the central station. Ordinarily this switch plug is entered into a fixing giving connection with earth, but when required it is inserted into the push key connected to one of the street alarm boxes, and then communications can be transmitted directly between the fire station and the particular street alarm box.

TRIALS OF THE JABLOCHKOFF AND WERDERMANN ELECTRIC LIGHTS IN PARIS.

SOME trials of the Jablochkoff and Werdermann Electric Light systems have recently been made at the French National Opera House, Paris. The experiments took place in the Opera *foyer*, or green-room, in the presence of a large number of persons interested in the result of the trials. The object in view was the comparison of the two systems.

Ten chandeliers were taken for the experiments, four being lighted by each system and the remaining two by gas.

The first experiments were made with the Jablochkoff system, the candles being covered with yellowish coloured glass globes was to cut off as much as possible the violet rays which characterise the light when obtained by the voltaic arc. "The result," says *L'Estafette*, "was to bring out all the defects of the system, as the light continually flickered, changed colour, and produced a disagreeable noise. The Werdermann light, on the contrary, was perfectly steady and quiet in character, but from the absence of glass globes was not quite so warm in tone as its rival. This, however, was an intentional defect, as Mr. Werdermann purposely exposed the light in a naked state so that its natural warmth might be seen; of course, a globe slightly coloured only would tone down the light to the required tint."

As regards steadiness and noiselessness, the Werdermann light unquestionably carried the day. As regards economy, it may be stated that the 12 Werdermann lamps (three for each chandelier) were produced by a steam engine of 6 horse-power, constructed by Hermann-Lachapelle; the 8 Jablochkoff candles (two to each chandelier) were produced by a 12 horse-power Calla engine. The dynamo machine for the Jablochkoff system was turned at a higher velocity than that for the Werdermann system; a difference requisite in consequence of the Jablochkoff candles requiring intensity currrents, whereas the Werdermann lamps are worked by quantity currents. This latter fact, although to the advantage of the Werdermann system when the lamps are placed close to the source of power, is a disadvantage when the two elements are distant one from the other, as very thick and expensive conducting wires would be required. Experiments made with the Werdermann light have shown that 5 lights, equal to 25 to 30 gas jets, may be obtained with a 1 horse-power engine.

The outlay incurred by using the Werdermann system is considerably less than that necessitated by the adoption of the Jablochkoff light, and this is no insignificant gain. It remains now for M. Garnier, the architect of the Opera house, to make his report to Government concerning the two systems, and to indicate which, after mature reflection, has the superiority. The result will be looked for with interest.

RAPIEFF'S CURRENT REVERSER.

AN ingenious form of current reverser has been devised by M. Rapieff, which is admirably adapted for reversing in cases where the currents in question are very powerful ones, and are liable therefore to burn up the contact points of any ordinary form of reversing switch; moreover, the new reverser is so arranged that it can be worked from a distance by sending a current through it from a small local battery.

Figs. 1, 2, and 3 show a front and side elevation and a section of the reverser. The apparatus is formed of a wooden block with three hollows, q, q, q, cut in it, which are partially filled with mercury. Four metallic discs (d^1, d^2, and d^3) on one axis dip their peripheries into this mercury. The two centre discs (d^2) are fixed close to, but at the same time are elec-

trically insulated from each other; they both dip into the same mercury chamber. The extreme left hand disc (d^3) is electrically connected to the left hand centre disc, and dips into the left hand mercury chamber. The extreme right hand disc (d^1) in like manner is electrically connected to the right hand centre disc, and dips into the right hand mercury chamber.

The left and right hand mercury chambers are electrically connected together and are connected to a terminal. The centre mercury chamber is connected to another terminal, and finally the left hand pair of discs are connected to one terminal, and the right hand pair to another terminal.

The metallic discs have each a portion of their surface coated with an insulating material, as shown in the figs. by the shaded portions, so that only about a quarter of each of their metallic surfaces are exposed. The relative positions of these latter surfaces with respect to each disc is such that in one position the bare surfaces of the extreme left hand disc and the right hand centre disc are immersed in the mercury chambers, whilst the other discs remain insulated; but if the whole set of discs be rotated through 180° on their axis, then the bare surfaces of the extreme right hand and the left hand centre discs come in contact with the mercury in their respective chambers, whilst the other discs become insulated. It is easy to see that if wires be connected to the four terminals the currents passing through them will become reversed in direction by the turning of the discs through an angle of 180°.

The turning of the discs is thus effected: at the end of the axis on which the discs are fixed are circular magnetic needles surrounded by ordinary galvanometer coils (m m'), so that when currents are caused to traverse them they turn the needles as in an ordinary galvanometer, and this with a weak current. By sending a current in one direction or the other through the coils it is evident that the needles can be turned through an angle of 180° in a corresponding direction, and by thus turning the discs will reverse the direction of the main current as required. The circular or disc shape given to the magnetic needles, M. Rapieff states, is found to answer very well in practice and to give considerable turning power.

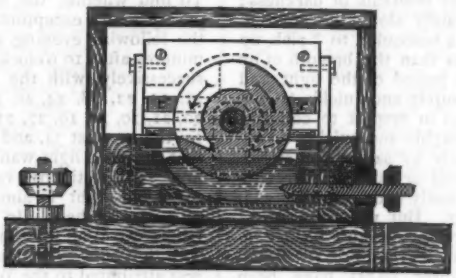


Fig. 1.

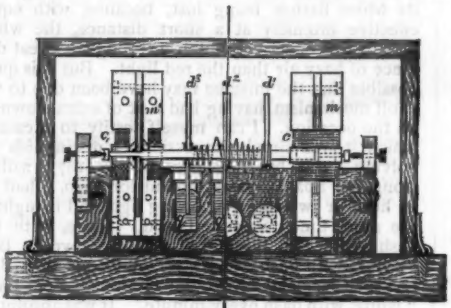


Fig. 2.

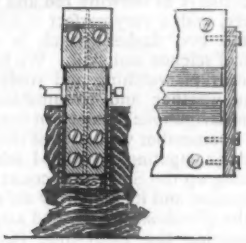


Fig. 3.

SIR WILLIAM THOMSON ON DISTINGUISHING LIGHTS FOR LIGHT-HOUSES.

The following letter has been written by Sir William Thomson to the *Times;* as its contents are of an extremely interesting character we are induced to reprint it in full:

"SIR,—A most interesting experimental cruise of ten days on board Her Majesty's ship *Northampton*, in the English Channel, from which I have recently returned, has given me many good opportunities of observing the lights on the south coast of England, and has revivified my conviction of need for a threefold reform in our lighthouse system, which I have been urging and re-urging since 1872 with hitherto but partial success:—A great quickening

of nearly all revolving lights; the application of a group of dot-dash eclipses to every fixed light; and the abolition of colour as a distinction of light-house lights, except for showing dangers and channels and ports by red and white and green sectors. Of about 120 revolving lights on the English, Scottish, and Irish coasts, there are in all 18 in which the periods are ten seconds or less and the times of extinction seven seconds or less. In these quick revolving lights the place of the light is not practically lost in the short intervals of darkness; the eye sweeping deliberately along the horizon, with or without the aid of a binocular, to "pick up the light," passes over less than the breadth of its own field of view in the period of the light, and thus picks it up almost as surely and quickly as if it were a fixed light. And so in respect to compass bearings, whether taken roughly and quickly by inspection or more accurately by azimuth compass, the bearing of the ten-second or quicker revolving lights is taken almost as easily and accurately as if the light were continuous. But what a contrast this is to the case of the ordinary minute-period revolving light! or even the half-minute period, to which some formerly slower lights have been quickened. We had before us during our cruise in the *Northampton* excellent and interesting specimens of lights of these two periods in the Start and the Wolf. The Wolf, a half-minute light, is interesting particularly as showing red and white flashes alternately, with a very perfect equalisation of intensity of the two flashes, which is quite a triumph of optical science and skill. We had excellent opportunities of watching and studying these lights in clear weather and circumstances altogether free from navigational anxiety on board the *Northampton;* but I remember well at least two previous occasions when (navigating myself) I felt great difficulty in picking up the Start on account of its 54 seconds of extinction and its niggardly six seconds of visibility. In the *Northampton* we had ample opportunities of comparing the Eddystone (fixed light) with the Start in respect to ease of taking their compass bearings. The great contrast between them in this respects renders the Eddystone practically a much more valuable aid to navigation than the Start. The first picking up of the Eddystone contrasted very favourably with our experience in this respect of the Wolf. The Eddystone was picked up and its compass bearing taken by inspection to less than a quarter of a point, when the light was so faint on the horizon that it could scarcely be seen, or not seen at all without a little motion of the eye to refresh its sensibility. The Wolf could not be seen at all, or if seen for an instant would be lost again for many of its reappearances, until it was very much brighter than the Eddystone had been when it was effectively picked up and used. When the Wolf did come well into view, bright enough to let no flash be lost, I was agreeably surprised by the ease with which its compass bearing could be taken with all needful accuracy, and I had almost come to the conclusion that the half-minute was quick enough; but, alas! I soon found that the convenient quickness was a temporary irregularity, and that when the light seemed almost satisfactory in point of speed it was making its period more nearly a quarter of a minute than half a minute. To ascertain the truth I observed the light carefully for 15 periods, writing down the hour, minute, and second of the beginning and end of each flash. The successive periods, each stated in seconds, were 40, 35, 27, 33, 32, 32, 32, 30, 29, 26, 25, 26, 25, 19, 23, of which the least is 19, the greatest 40, and the mean 28·9. The times of darkness were 28, 24, 19, 24, 23, 23, 23, 20, 20, 19, 18, 19, 17, 13, 16, of which the least is 13, the greatest 28, and the mean 20·27. This was from 6.40 to 6.50 on the evening of the 8th of November. To find whether the irregularity was only temporary and exceptional, I observed again on the following evening, commencing this time a few minutes after 10 o'clock, and observing 24 periods successively, with the following results: 22, 22, 21, 25, 22, 28, 24, 28, 22, 30, 33, 29, 20, 26, 20, 22, 20, 21, 20, 22, 19, 27, 23, 24, of which the least is 19, the greatest 34, and the mean 23·7. It is clear that the Wolf light wants a good centrifugal governor. The distinctive value of a definite period in a revolving light is almost annulled by such irregularities as these. In fact, a serious case of mistaking the Wolf for the St. Agnes (Scilly Islands), a minute-light, has been reported. The mistake was attributed to the Wolf having been seemingly converted from a half-minute to a minute-light by its white flashes being lost, because, with equal effective intensity at a short distance, the white light is less effectively intense through a great distance of hazy air than the red light. But it is quite possible that the mistake may have been due to the Wolf mechanism having had a fit of extra slowness on the occasion. I can myself testify to a case in which it was simply impossible to distinguish revolving lights by their periods. In 1877, sailing along the Spanish coast bound for Vigo, I had for an hour or two three revolving lights all in sight at the same time: Salvora Island, "white, with red flash every two minutes;" Ons, Pontevedra Bay, "white, with flash every two minutes;" and Bayona, or Cies Islands (in the mouth of Vigo Bay), "white, with flash every minute." It was absolutely impossible to distinguish the three lights according to the description of them, quoted as above, from the Admiralty "List of Lights." The red flash of the Salvora light was not perceptibly different from the white flashes of the two others, and as to periods, the Salvora and Ons lights, each professedly of two minutes, did not differ sensibly from the Bayona light, which this time kept almost correctly to its one-minute period. But in later editions of the Admiralty "List of Lights," I see a warning of irregularity in respect to this same Bayona light, to the effect that in September, 1872, Capt. Brandreth, R.N., in Her Majesty's ship *Lord Warden*, observed it to flash every half-minute.

"Except in one unimportant case—the Dungeness Low Light, which flashes every five seconds—all the revolving lights of the English Channel are too slow, and it would be an unspeakable improvement if, with that exception, every one of them had its speed sextupled. There is no mechanical difficulty in the way of doing this. Generally the same mechanism would suffice with a mere change of adjustment of the governor; but the lightkeeper would have to wind up the weight oftener or longer. Then, instead of the two-minutes period of the Beachy Head Light with its minute and three-quarters of extinction, we should

have a 20-seconds period, and the invisibility only 15 seconds. The Start and the St. Agnes would then give a flash every 10 seconds, and the Wolf a flash every five seconds, which is the same as Buchan Ness, the Rhynns of Islay, and the little Ross, on the Scottish coast, undoubtedly the three best revolving lights in the world. What an unspeakable improvement this would be to the lighting of the Engish Channel! The triple-flash light of the Royal Sovereign Shoals Lightship is at present very admirable, and to a patient enough observer, with time enough to spare, it is thoroughly distinctive. But the 37 seconds of darkness is a serious defect of that light, and the slowness of the three flashes, occupying the remaining 23 seconds of the period, is an altogether unnecessary derogation from the distinctiveness of character which greater speed would give them. Three short flashes in three or four seconds, with an interval of six seconds of darkness, would have an instantly recognisable rhythm (letter S of the Morse flashing alphabet); and, when once described, the light would be known to be what it is and nothing else, even before the completion of two of its 10-seconds periods.

"Revolving lights are, however, but a small minority of all the lighthouses of the world. Of the 623 lights of the British and Irish coasts, just 110 are revolving lights, and the remaining 513 are fixed, and there is a crying want of distinction for fixed lights. The distinction by colour alone ought to be prohibited for all lighthouse lights, on account of its liability to confusion with ships' and steamers' side-lights. Southsea Castle, with its red and green port and starboard side-lights, seems as if actually planned to lure on to destruction an unsuspecting enemy carefully approaching the coast with Thomas Gray's happy rule well impressed on his mind:

"'Green to green, and red to red,
Perfect safety, go ahead.'

He does so, and is wrecked on Southsea beach.

"My proposal for supplying the want is to distinguish every fixed light by a rapid group of two or three dot-dash eclipses, the shorter, or dot, of about half a second duration, and the dash three times as long as the dot, with intervals of light of about half a second between the eclipses of the group, and of five or six seconds between the groups, so that in no case should the period be more than ten or twelve seconds. This proposal has been carried into effect with perfect success in Holywood Bank Light, Belfast Lough, now the leading light for ships entering the Lough, but which until 1874 was enclosed in a red glass lantern and was only visible five miles, and was constantly liable to be mistaken for a sailing vessel's port-side light entering or leaving the harbour of Belfast, or the crowded anchorage of Whitehouse Roads. In 1874 the red glass was removed, and the light was marked by dot, dot, dash (— — ——, or letter U), repeated every ten or twelve seconds, and has been so ever since. It is now recognised with absolute certainty practically as soon as seen in ordinary weather from the mouth of the Lough, ten miles off, and has proved most serviceable as leading light for ships bound for Belfast or entering the Lough.

"It is much to be desired that the dot-dash system should be seriously considered by the lighthouse authorities of our islands. Hitherto, when attention has been called to it, it has been dismissed with a pleasantry, 'Winking lights won't do,' or else something utterly different has been gravely considered and justly condemned. It is satisfactory now to know that the Deputy Master of the Trinity Board, Sir Richard Collinson, K.C.B., has, after its character was correctly put before him by the recent Select Committee of the House of Commons on Electric Lighting, given it his approval in the concluding answers of his evidence.

"Is it too much to hope that when the new Eddystone Lighthouse is finished the light shall not be, as hitherto, an undistinguished fixed light, but a fixed light distinguished by a group of dot-dash eclipses — such as dot, dash, dot (— ——— — letter R)—which is particularly easily distinguished by its rhythmical character; and that the Needles Light, which shows red over a great area of sea south of it, and when undistinguished, as at present, is liable to be inconveniently and even dangerously mistaken for a ship's port-side light, shall have a distinctive dash, dot (——— — or letter N) given to it, which, whether in its red or on its white sectors, will instantly show it to be itself and no other light at sea or on shore? The five years' practical demonstration of the dot-dash system in Belfast Lough ought surely to weigh with the authorities. The introduction of a well-proved remedy for an admitted defect of our lighthouse system should not need that advocacy which moved the unjust judge, and the seafaring world should not suffer the delay in gaining a great benefit which the strict following of that judge's precedent would entail.

"I remain, your obedient servant,

"WILLIAM THOMSON.

"The University, Glasgow."

HOWELL'S BATTERIES.*

By C. F. HOCKIN.

HAVING lately tested several of these elements, I think the results may be interesting to some of your readers, particularly as the cell in question is, I believe, a very good one, and has a higher electromotive force than any cell with which I am acquainted.

The plates are zinc and carbon.

A cylindrical glazed porcelain vessel, about 6½ inches high and 5½ inches in diameter, contains a smaller cylinder 6¼ inches high and 2½ inches in diameter, of the same material, which is open at both ends and has four longitudinal slots in its walls.

The smaller cylinder stands with its axis vertical in the larger vessel.

In the space between the inner wall of the larger cylinder and the small cylinder (called the separator) is placed first a rod of carbon, on to which is fitted a terminal.

Around this block is a mass of broken carbon and peroxide of manganese, filling the clear space described to within about 1½ inches of the top of the cylinder. On the top of the mass is placed a layer of white manganese or native sulphate of

* An illustrated description of this battery was given in our last number.—ED. TEL. JOUR.

manganese. The whole is kept in place by pouring hot pitch over it to the level of the top of the vessel.

Within the separator stands a cylindrical porous pot 6½ inches high and 1⅝ inches in diameter, containing the electro-positive electrode, viz., amalgamated zinc with some free mercury.

The solution in which the zinc is placed is made by dissolving 25 grammes crystals of sulphate of ammonia in one litre of water, or say, a 2½ per cent. solution.

The electro-negative element is in dilute sulphuric acid, one part acid to four parts water.

Several cells were tried.

First.—Five cells, Nos. 1 to 5, made and set up as described.

Second.—Two cells, Nos. 6 and 7, similar to the first, but in which the sulphate of manganese was omitted.

Third.—Five cells, Nos. 8 to 12, similar to Nos. 1 to 5, but in which an impure sample of manganese had been used. The results from these cells are given only to show the importance of purity in the salts used with the electro-negative element of any cell.*

Lastly.—Four ordinary Leclanché cells (Silvertown pattern, No. 2) were filled with the following solutions :—

No. 13. Dilute sulphuric acid, 250 grammes water and 12½ grammes acid.

No. 14. Same as above, with 6¼ grammes of sulphate of ammonia.

No. 15. 250 grammes water with 6¼ grammes of sulphate of ammonia dissolved in it.

No. 16. 250 grammes water with 6¼ grammes of chloride of ammonium dissolved in it (the normal Leclanché battery).

The weights given are of the crystalline salts.

When first set up, and before any current had passed through them, the electro-motive force of the cells was as follows, in volts :—

No. 1...2·146	No. 6...2·119	No. 8...2·112	No. 13...1·917
,, 2...2·151	,, 7...2·080	,, 9...1·912	,, 14...1·917
,, 3...2·168		,, 10...2·135	,, 15...1·544
,, 4...2·155		,, 11...2·033	,, 16...1·547
,, 5...2·130		,, 12...1·864	

From these values it appears that a Howell's cell has an electro-motive force exceeding that of even a Groves' cell (1·94 volts, Electrical Formulæ, Clark and Sabine, p. 97) by nearly 10 per cent., and exceeding that of an ordinary Leclanché cell filled with dilute sulphuric acid by 12 per cent., showing that, as might be expected, the electro-motive force is increased by the use of two liquids, one for the electro-positive plate, the other for the electro-negative.

The variation in the electro-motive force found between different cells of the same pattern was almost wholly due to the electro-negative plate, for the result was the same whether the same plate of zinc was used for all the cells, or each cell had its own plate.

The cells Nos. 8 to 12 do not show any distinct variation in electro-motive force due to the strength of the acid solution used, the irregularity in the values is due to the impurity of the manganese.

* In these cells the strength of the acid solution was as follows : No. 8, 5 per cent. acid ; No. 9, 10 per cent. ditto ; No. 10, 15 per cent. ditto ; No. 11, 20 per cent. ditto ; No. 12, 25 per cent. ditto.

Nos. 15 and 16 show that the presence of free acid, and not the nature of the salt of ammonia used, determines the high electro-motive force of the cell.

The resistance of the cells 1 to 12 averaged, when first set up, 5·7 ohms each.

To determine the work that could be obtained from the cells, Nos. 1 to 7 were allowed to run through an external resistance of 1,000 ohms, corresponding to a total resistance of 147 ohms per cell, for 16 days, from October 23rd to November 8th, without the circuit being at any time broken, and the effective electro-motive force was observed from time to time.

By the effective electro-motive force is meant the electro-motive force between the ends of the external resistance, measured while the current was flowing, or, the electro-motive force available for maintaining the current in the circuit. The results are in volts.

Date.	Total E.M.F. of Series.	Average per Cell.	Date.	Total E.M.F. of Series.	Average per Cell.
Oct. 23	14·39	2·06	Nov. 1	13·49	1·93
,, 24	13·90	1·99	,, 2	...	...
,, 25	...	...	,, 3	13·39	1·91
,, 26	...	...	,, 4	13·37	1·91
,, 27	13·63	1·95	,, 5	13·29	1·90
,, 28	...	...	,, 6	13·29	1·90
,, 29	...	...	,, 7	13·17	1·88
,, 30	13·53	1·93	,, 8	13·07	1·87
,, 31	13·58	1·94			

Showing an average loss in electro-motive force of only 0·6 per cent. per day during 16 days, and an average available electro-motive force of 1·96 volts per cell, the battery working through a total resistance of 147 ohms per cell, or about 13 miles of No. 6 iron wire.

The electro-motive force of each separate cell is given for certain dates.

No. of Cell.	Date and E. M. F. of Cell.					Percentage loss in E. M. F.
	Oct. 23.	Oct. 24.	Oct. 30.	Nov. 4.	Nov. 8.	
1	2·065	2·061	2·027	2·056	2·068	— 0·1
2	2·069	2·074	2·086	2·069	2·067	+ 0·1
3	2·085	2·079	2·041	2·004	2·022	+ 3·1
4	2·073	2·042	1·965	1·843	1·727	+ 16·7
5	2·048	1·923	1·673	1·466	1·391	+ 32·1
6	2·038	1·931	1·981	1·933	1·842	+ 9·6
7	2·009	1·785	1·751	2·030	1·943	+ 3·0

From these values it appears that the electro-motive force of the cells at starting was fairly uniform, the cells with white manganese having rather a higher electro-motive force than those without it.

After working through 147 ohms per cell for 16 days the results were not so uniform. Cells 1 to 3 had lost very little in electro-motive force and had contributed a nearly uniform quota to the whole current traversing the circuit throughout the time.

Cells 4 and 5 had diminished considerably in power.

Nos. 6 and 7, which were set up without the white manganese, had lost on the average about 6 per cent. in electro-motive force at the end of the time, but had varied considerably during the time.

The cause of irregularities in cells of the same pattern was, probably, impurity in the manganese.

Cells 8 to 12, filled with impure manganese, were treated as follows :—

First, they were short-circuited for 24 hours, through an external resistance of 30 ohms, or a total resistance of about 12 ohms per cell; after 24 hours the electro-motive force fell to 3·06 volts, or an average of only 0·6 volts per cell.

After the circuit had been broken the electro-motive force rapidly increased; in ten minutes the values were as below :—

	Volts.		And after 24 hours. Volts.
No. 8 ...	1·638	No. 8 ...	1·870
,, 9 ...	1·693	,, 9 ...	2·040
,, 10 ...	1·019	,, 10 ...	1·690
,, 11 ...	1·597	,, 11 ...	1·877
,, 12 ...	1·408	,, 12 ...	1·977
Total	7·355	Total	9·454

A little more acid was then added to each cell, to fill them to the proper height, and the cells were allowed to run through an external resistance of 500 ohms, or a total resistance of 106 ohms per cell for 17 days. The electro-motive force varied as given below:—

	Volts.		Volts.
October 22nd ...	9·45	November 1st ...	5·79
,, 23rd ...	7·68	,, 3rd ...	4·87
,, 24th ...	7·62	,, 4th ...	4·76
,, 27th ...	7·23	,, 5th ...	4·61
,, 30th ...	6·72	,, 6th ...	4·42
,, 31st ...	6·36	,, 7th ...	4·23
		,, 8th ...	4·14

In 17 days, therefore, the cells had fallen to an average electro-motive force of only 0·83 volts, or about that of a Minotto's cell, showing the great effect of the impurity in the electro-negative plate.

Lastly, the four Leclanché cells, Nos. 13 to 16, were allowed to run through an external resistance of 100 ohms, or a total resistance of 38 ohms per cell for 24 hours; after this time the results were as follows :—

Original E.M.F.				E.M.F. after 24 hours work.
No. of Cell.	Volts.			Volts.
13 ...	1·917	...	...	1·409
14 ...	1·917	...	...	1·338
15 ...	1·544	...	...	0·059
16 ...	1·547	...	...	0·444

The cells without acid had, therefore, lost their electro-motive force, while those with acid had fallen to about 0·717 of their original value.

I think the values that have been given show that for many kinds of ordinary telegraphic work Howell's batteries are superior to any other in common use.

Whether they will answer for testing purposes, that is to say, whether they will maintain when at rest or when working, through a very high resistance, an absolutely uniform electro-motive force not subject to sudden instantaneous changes, I cannot say, as the only way to prove this is to observe the current from many cells entering a condenser of high capacity and very great resistance. It is perhaps unlikely that an acid battery will fulfil these conditions.

The use of a rather strong solution of sulphuric acid in these batteries will be disadvantageous under some circumstances, and in such cases the ordinary Leclanché will be preferred.

The maximum electro-motive force to be obtained by the formation of sulphate of zinc from sulphuric acid and zinc is theoretically about 2·35 volts, and to obtain an electro-motive force so near this as 2 volts under such conditions as are commonly met with in telegraphic work is a very good result.

The cell of course is not suited for working through a low resistance, and cannot take the place of a Groves' cell, a Bunsen's cell, or a very large Daniell's cell such as is used for electrolysis.

The numerical values given in this paper are based on the value of a certain Clark's cell. This cell was compared with a Daniell's cell set up with pure materials—a cell similar to a Clark's element, but in which a certain known solution of sulphate of zinc not saturated was used—and with other cells, to prove that it had not altered.

EDWARDS' SOUNDER.

A NEW form of sounder has recently been devised and patented by Mr. J. R. Edwards, Superintending Engineer of Postal Telegraphs, Liverpool.

The object of this invention is to enable "sounders" to be actuated directly by the line

FIG. 1.

current, whether double or single, thereby rendering unnecessary the intervention of a relay and local battery power, as in the case of the ordinary "Morse" sounder, and thus simplifying and economising the means of telegraphic communication.

The instrument is shown in front and side elevation by figs. 1 and 2. It consists of a stand carrying a

D shaped permanent magnet, one pole being made longer than the other and placed uppermost. Below this long pole is fixed a single bobbin electro-magnet having a soft iron core passing through the long pole of the permanent magnet, and magnetised by it, and made in two parts, the lower part being fixed in the bobbin and the upper part capable of being adjusted at any required distance from the other by a screw, shown at the top of the bobbin, carried on a bracket on the long pole of the magnet.

Below the shorter pole of the permanent magnet and also directly below the top electro-magnet is placed another single bobbin electro-magnet, with an iron core capable of being adjusted in regard to its height above the coil by an adjusting screw below. It will thus be seen that the iron cores of the electro-magnets face each other, with a space between them capable of being adjusted at will.

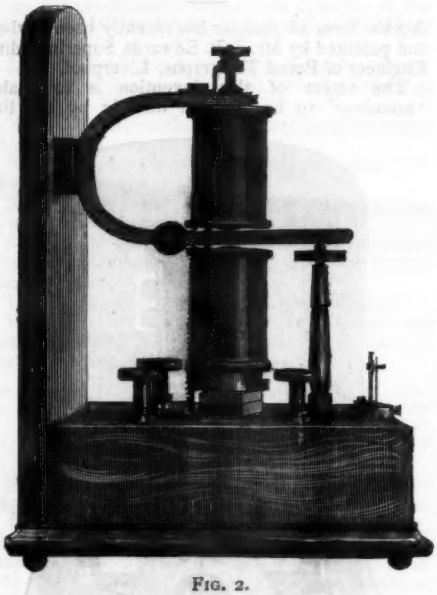


FIG. 2.

A soft iron armature prolonged at its outer end by a brass bar is hinged or pivotted to the short pole of the permanent magnet and magnetised by it; the end of the brass bar, when depressed, strikes against the end of an upright brass column, which is screwed on to the base of the instrument, the latter being hollow so as to give out a good sound.

The various connections are of course coupled up to the key and battery, as will be well understood.

In working the instrument a current passing through the coils of the electro-magnets reverses the polarity of the core of the upper electro-magnet, releasing the armature, which besides falling by its own gravity is attracted by the opposite pole of the lower electro-magnet, thus striking the top of the brass column and producing a sound.

The lower electro-magnet pole is not affected by the permanent magnet, as it is magnetised by the line current only when passing.

No reacting spring to raise the vibrating armature is needed, as the permanent magnet magnetising the pole or core of the upper electro-magnet raises the armature directly the line current is off, and this degree of magnetism is regulated as described by having the upper core in two parts adjustable to each other.

If the apparatus is worked on the "double" current system then it can be much more delicately adjusted, as the reversal can be caused to raise the armature to its normal position.

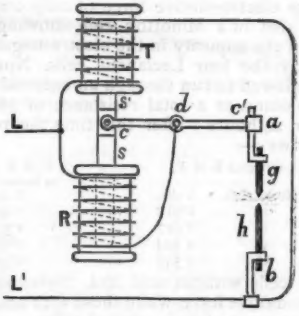
The instrument when adjusted will give a good readable sound when traversed by a current of about 10 milliwebers (1 Daniell cell through 100 ohms resistance).

A small galvanometer is placed in the front of the instrument to indicate whether a current is passing or not, should the instrument fail to work.

SIEMENS' DIFFERENTIAL ELECTRIC LAMP.

THE general principle of this lamp is shown by fig. 1: *g* and *h* indicate the carbons held respectively in the sockets *a* and *b*, and provided with means of feeding as they are consumed. The one

FIG. 1.



socket *a* is attached to one arm c^1 of a lever pivotted at *d*, and having its opposite arm *c* connected to a piece of non-magnetic material uniting a pair of iron cores *s*, s^1. The core *s* is free to play up and down within a solenoid R, the coil of which is of large wire offering small resistance, and forms part of the lamp circuit. The core s^1 is free to play up and down within a solenoid T having a coil of smaller wire offering greater resistance than the coil of R. The coil of T is in a circuit external to the lamp, that is to say, joining the conductors L, L^1, excluding the carbons. When the solenoid R, being excited, draws in its core *s*, the points of the carbons are separated; when on the other hand the solenoid T draws in its core s^1 the carbons are caused to approach each other. As the relative force of the two solenoids depends upon the strengths of the currents of electricity passing respectively through their coils, and as this depends upon the relative resistance of their respective circuits, the one circuit

consisting of the coil T and its connections to the main circuit of L, L^1, and the other consisting of the coil R, the two carbons, and the arc between them; that portion of the latter which consists of the arc being dependent on the distance of the carbons apart, this distance will become adjusted automatically by the action of the two solenoids, so as practically to maintain constant action of the lamp. If, for example, the carbons should be too near together a larger proportion of the electric current passing through the coil R than through the coil T will cause superior attraction of the core *s*, separating

FIG. 2.

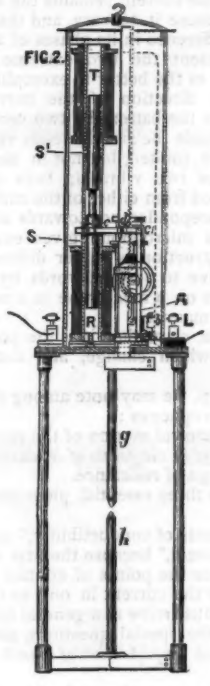
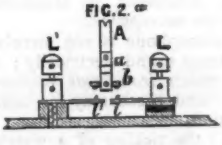


FIG. 2a.



the carbons, and thereby increasing the resistance of the arc between them, and so lessening the quantity of electric current that passes through them. If, on the other hand, the carbons should be too far apart, then the coil R being less excited than the coil T, will exert less attractive force on its core *s*, permitting the other core s^1 to be drawn into its coil, and thus causing an approach of the carbons which will lessen the resistance of the arc between them, and so permit the passage of a larger proportion of the current through them; thus the regulation of the lamp being dependent only on the resistance of its voltaic arc, and independent of the strength of current, the action of any one lamp in a circuit will not affect that of other lamps in the same circuit, and consequently a number of such lamps can, by means of this invention, be effectually worked in one and the same circuit. Fig. 2 is a vertical section of a lamp with a pair of regulating solenoids operating as described with reference to fig. 1 in combination with one of the arrangements for feeding the upper carbon described in the Specification before referred to. In this construction R is the one solenoid having its coil of low resistance in the lamp circuit surrounding the core *s*, which is connected to the lever arm *c*. The other solenoid T having its coil of higher resistance in a circuit external to the lamp surrounds the core s^1, which is connected by a piece of non-magnetic material to the core *s*. The lever *c* is pivotted at *d* on the fixed framing of the lamp, and carries on its arm c^1 the slide and rack for the upper carbon, and the disengaging gear described in the Specification before referred to, which permits the carbon slide to descend a little to allow for waste when the automatic adjustment effected by the action of the solenoids brings the disengaging gear down to a fixed stop. To provide for continuation of the circuit in cases where a considerable separation of the carbons *g*, *h*, occurs, as when a piece of the carbon breaks off, the following arrangement is adopted:—To the frame A (which is moved up and down by the action of the solenoids R and T) is attached an insulated bracket *a*, of which a front view is shown at fig. 2a. On this bracket is pivotted a lever *b* immediately over two spring contacts *l*, l^1, connected respectively to the conductors of the external circuit. When the frame A descends to its full extent the lever *b*, resting on the contacts *l*, l^1, completes the external circuit, so that other lamps in that circuit may continue in action, even if the one lamp becomes extinguished. When, by the approach of the carbons, this lamp again comes into action, the lever *b* is raised off the contacts *l*, l^1, by the ascent of the frame A.

THE TRANSMISSION OF MOTIVE POWER BY ELECTRICITY.

FOR some months back Messrs. John Poynter and Son have, at the Shaws Water Chemical Works, been practically and successfully testing the practicability of the transmission of motive power by electricity. The machines used are the well-known Siemens' Dynamo Electric Machines, the same with which electric lamps are worked, and the liberal supply of water from a waterfall behind the works put into the hands of the firm a cheap and handy driving power. One of these Siemens' machines is placed in a part of the works quite near this waterfall, and beside a turbine wheel, while another machine of the same kind is placed in the engineers' shop, about 150 yards off. These two machines are connected with electric wires. Briefly stated, the following is the mode of working. The water is brought from the fall, and drives the turbine wheel, while the first-mentioned electric machine is in turn driven from the shafting of the turbine by the ordinary means of belting. The electric power

generated in the Siemens' machine is then transmitted by means of the wires through the various departments of the works to the machine in the engineers' shop. To that machine a belt is attached to drive the shafting, and in that way motive power is gained in the engineers' shop, the cooperage, and other parts of the works. For instance, the shafting driven by this electrical current from the wires attached to the Siemens' machine drives a circular saw in the cooperage, and in the engineers' shop a turning lathe and a vertical boring machine, which latter machine we saw penetrating an iron plate one inch thick with a $\frac{3}{4}$ inch bit. In a word, by the Siemens' machine placed at the turbine wheel the water-power is converted into electricity, and by the other machine in the engineers' shop the electricity is converted into valuable motive power. It must be kept in mind that the Messrs. Poynter have abundance of steam and water-power at command, and have, as stated above, tried the electric power as an experiment. These two machines can furnish from two to three horse-power, and while, of course, that is not sufficient for many practical purposes, the importance of this successful experiment by the Messrs. Poynter lies in the untold probabilities of motive power which further development of the idea may give. The experiment witnessed by us the other day at the Shaws Water Chemical Works is, so far as we know, the first of the kind in Scotland, and it only remains to be added that the press representatives on visiting the works were shown every courtesy and attention by Mr. Poynter and his assistants, Messrs. Macdonald and Cunningham.—*Greenock Herald.*

NEW RESEARCHES ON THE THEORY OF THE MICROPHONE.

By DR. JULIAN OCHOROWICZ.

II.

THE fourth class of microphones embraces those in which the current itself is produced and varied solely by the movements of the microphonic electrodes ;* these are *microphonic batteries.* Every battery may, under certain conditions, act as a microphone ; it is only necessary that one of the poles be movable. Two pieces of iron wire plunged into plain water, and brought near each other, give indications of microphonic action. Suppose then one of the poles of a battery attached to a vibrating membrane in the form of a small cone, as shown in fig. 1, the apex of which dips into the liquid, while the other pole is permanently immersed therein. The current only exists when the movable pole touches the liquid ; singing into the tube sets the membrane in vibration, and the pole, which is then one of the microphonic electrodes, dips into the liquid, and sets up chemical action as many times per second as there are vibrations in the note sounded. If the pole constantly touches the liquid the current is never broken, but varies in intensity according to four collateral causes :

1. Varying number of points exposed to electrolytic action.
2. Varying number of points making electrical contact.
3. Varying number of points of resistance of liquid stratum.
4. Varying approximation of the poles.

But it is evident that these are but four expressions of the same thing, namely, the motion of one of the *microphonic electrodes.*

It only remains for us to examine the last class of microphones. In all those hitherto known the direction of the current remains the same ; but it is possible to cause it to vary, and thus to introduce one other difference in its phases of action. Figs 2 and 3 represent the two extreme positions, exaggerated so as the better to exemplify the change ; we see the direction of the current, which is brought from the battery by two very fine wires so as not to impede the simultaneous vibrations of the two vibrators (united, but not in electric contact). In reality the two vibrating balls are never completely isolated from either of the carbons, but there is always a preponderance towards one side or the other. This microphone gives excellent results, but its construction is rather difficult. I make it more sensitive to spoken words by adjusting the two vibrators on a membrane in a somewhat more complicated manner.

In this last class then it is the points of contact themselves which change, and not merely their number.

To sum up, we may note among all the possible forms of microphones :

1. A mechanical motion of the parts.
2. *A change in the points of conductibility.*
3. A change of resistance.

And these three essential phenomena result from each other.

I say "points of conductibility," and not of "contact." "Contact," because the first expression embraces at once the points of contact and the route traversed by the current in one or the other direction. We thus arrive at a general formula. Let us now attack the special questions, above all, that of the pretended *amplification of sounds* by the microphone.

It is easy to see that this does not take place. *All sounds, considered by themselves, are always weakened by the microphone.*

But the microphone is not merely an apparatus which transmits sound electrically ; it is more especially one which *transforms mechanical vibrations into sound ;* and these may be amplified in this transformation.

Example : the ticking of a watch placed on the same plank as a microphone can be distinctly heard, although at a distance of six or seven metres. If the watch is placed on the base of the microphone itself, the sound can be heard all over a room, because it acts, not as a *noise,* but as a *mechanical vibration.* But this same watch becomes incapable of affecting the microphone when held in the air at a distance of a few millimetres, because then it acts only by its *noise.* On the other hand, a faint breath of air, though making scarcely any noise, gives the effect of wind.

The weakening of articulate sounds is greater as the sounds are more intense, so that the faintest

* I call *microphonic electrodes* the two opposed portions of the microphone which are united directly or indirectly.

sounds experience the least weakening. Simple musical sounds, accompanied by a mechanical vibration relatively great (for example, the current of air emitted from the mouth in singing or whistling), may be somewhat amplified by the microphone, which "makes and breaks," but this amplification only takes place when the sounds are feeble.

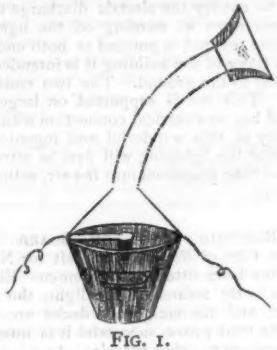


FIG. 1.

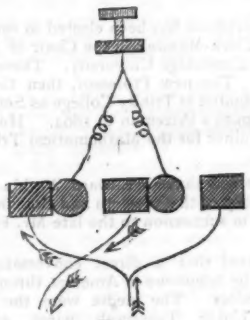


FIG. 2.

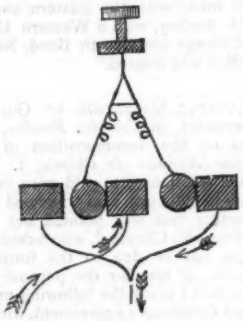


FIG. 3.

Mechanical vibrations, although unaccompanied by sound, are always transformed into sound, and this increases in intensity in proportion as the amplitude tends to interrupt the current. This interruption accomplished the augmentation at once ceases to show itself. A blast of air will act no more strongly than a breath, inasmuch as the latter is strong enough to produce a momentary but complete rupture of the current. There are two limits between which are comprised all the laws of microphonic phenomena: the inferior limit, where there is a minimum of mechanical vibration and in which a variation of contact is only just realised, and the superior limit, in which the vibration breaks the current, independently of the energy of such vibration. Beyond these there is neither amplification nor even articulation; but between them the intensity of sounds is directly proportional to the energy of the mechanical vibrations which accompany the sonorous waves. And as the vibrations of one or more parts of the microphone determine an augmentation or diminution of the number of points of good or bad conductibility we may conclude that—

The intensity of the sounds is directly proportional to the magnitude of the differential changes in the resistance of the microphone.

For the transmission of articulate sounds it is necessary that *the number of points of contact, the variations of this number during the action of the apparatus, and the variations of resistance resulting therefrom should be very great.* This is obtained in the second class of microphones by uniting small surfaces presenting only one point of contact, or by employing bodies of low conductivity. The interruption of the current is then only partial and undulatory, to use Bell's expression; and the greater the margin in this interruption or partial reconstitution the more perfect is the microphone.

THE MAGNETISM OF A WIRE TRAVERSED BY AN ELECTRIC CURRENT.

DR. BARKER has read before the National Academy, America, a paper detailing the results of certain variations of Arago's experiment to prove that a wire through which an electric current is passed becomes for the time a magnet. This view was overthrown by the tests applied by Professor Franklin Bache, some fifteen years ago.

Professor Bache placed a piece of cardboard against the wire in such a way as to cut the "magnetic field" containing the filings into halves. Immediately all the filings dropped. The inference was that the wire was not a magnet. The filings, it was believed, had been held in position before the interference of the cardboard in one of two ways: either by their magnetic adhesion to each other, or by the direct support of the currents circulating in the magnetic field. Dr. Barker has made some experiments to disprove these inferences. He employed a powerful magneto-electric machine of the Wallace pattern at Ansonia, Conn. The energy it developed was so enormous that at a distance of 7 feet an iron bar 5 feet long held opposite it would be instantly so charged with electricity as to hold up an ordinary nail. This current of electricity would heat to cherry-redness in a minute a ¾-inch gas-pipe 3 feet long. Dr. Barker performed the "experiment of Arago" with this machine, using a copper wire. Copper, being diamagnetic, seemed not so likely to become a magnet as iron. A 5-inch iron spike was held below and close to this wire during the passage of the current. The spike was attracted, but not sufficiently to lift it clear.

When the spike was touched to the wire, it immediately stuck fast at right angles to the wire. But when the spike was removed from the wire only the thousandth part of an inch, it fell to the floor. This showed that the great energy of the magnetism was in the wire, and not in the surrounding field. Then Dr. Barker had a glass plate prepared with a hole through its centre; the wire was passed through the hole, and iron filings sprinkled on the surface of the plate. When the current was passed through the wire, the filings arranged themselves in concentric circles around it. Further experiment showed, by reversing the wire current, that in this magnetic field the currents were travelling in circles around the wire. Finally, when the iron spike was held by the head parallel to the copper wire and near it, the spike deflected itself out of the perpendicular in the direction in which these currents were passing around the wire. Dr. Barker considers that his experiments yield conclusive proof that the old view was correct—that a wire through which a current is passing does become for a time a magnet.—*Scientific American.*

Correspondence.

JOINT FOR UNDERGROUND WIRES.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—As the usual way of joining gutta-percha covered wire requires great care and attention, I have devised the following method, which I find to be both quick and effective.

The two ends of the wires to be joined are bared as usual, then a piece of specially prepared india-rubber tube three inches long is drawn over one wire beyond where the joint is to be made, the two wires are then joined in the usual way, and the bit of tube is drawn over the joint and bound at each end with rather fine tar cord, the joint is then complete.

FREDERICK J. SMITH.

Taunton, Nov. 28, 1879.

Notes.

ELECTRIC CLOCKS. — Underground wires for synchronising a number of clocks by electricity are being laid down by the Municipal authorities in Paris; the synchronising system to be adopted is, we believe, that of Messrs. Lund and Blockley of Pall Mall, London.

THE TELEPHONE IN AMERICA.—On the 1st of September, 1877, the first telephone exchange was established in Cincinnati; there are now 800 subscribers on the company's books; 800 instruments are in use, and 3,000 miles of wire on 75 miles of poles are required for the working of the system. At the Exchange office, where the various subscribers have their offices "switched" through to one another, no less than 6,000 "switchings" take place every day.

THE BELL TELEPHONE.—Professor Bell has obtained a verdict in his favour from the United States Superior Court. By this verdict his patent rights in the United States will be protected, and no telephone will be permitted to be used unless it bears the name of A. Graham Bell. The shares of the National Bell Telephone Company, which has bought up all the conflicting rights, and acquired all the telephonic inventions of Elisha Gray, Edison, and Phelps, are quoted at 700 per cent.

A NEW LIGHTNING ROD.—A company in Cincinnati has patented a new system of protection from lightning. Unlike the ordinary lightning rod, which is designed to convey the electric discharge to earth, the new system aims at warding off the lightning. For this purpose the rod is pointed at both ends, and runs along the ridge of the building it is intended to protect, and parallel to the ground. The two ends are turned upwards. This rod is supported on large glass insulators, and has no electrical connection with the ground. The theory of this wonderful and ingenious arrangement is, that the lightning will first be attracted by the points, and then dispersed into the air, without harming the building.

THE ELECTRIC LIGHT ON BOARD SHIP.—The Inman s.s. *City of Berlin*, which left for New York on the 5th, has been fitted with Siemens' Electric Light apparatus. By means of the light, the saloon, the passenger, and the emigrants' decks are illuminated. Should the trial prove successful it is intended to extend the system to other vessels.

LORD RAYLEIGH has been elected to succeed the late Professor Clerk-Maxwell in the Chair of Experimental Physics in Cambridge University. There was no other candidate. The new Professor, then the Hon. J. W. Strutt, graduated at Trinity College as Senior Wrangler and first Smith's Prizeman in 1864. He was an additional examiner for the Mathematical Tripos in 1876.

IT is notified that Sir Edward Watkin has taken the Chairmanship of the Western and Brazilian Telegraph Company, in succession to the late Mr. H. Rawson.

IT is stated that a direct conversation has been carried on by telephone in America through a distance of 2,000 miles. The media were the railroad and Western Union Telegraph wires and Edison's telephone. One office was at Bethlehem, Pa., and connection was made with the Eastern and Amboy wire, and at Perth, Amboy, with a Western Union wire, and thence to Chicago and North Bend, Nebraska, where the other office was located.

THE GALVANIC OXIDATION OF GOLD.—Grotthuss, says M. Berthelot, in *Comptes Rendus*, in his classic experiments on the decomposition of water by the galvanic pile (*Annales de Chimie*, t. lxviii., p. 60), remarked the solution of a gold wire employed as the positive pole in sulphuric acid traversed by the current. This interesting fact was pointed out to me by our venerated dean, M. Chevreul, who asked me if such an effect might not be due to the formation of persulphuric acid. It was for the purpose of replying to his question that I made the following experiments: I first repeated Grotthuss's experiment, which is precisely as he described it. The sulphuric acid (at 10 per cent.) becomes yellow, and rapidly dissolves the gold wire. The dissolved gold can easily be detected by means of stannous chloride. A portion is reprecipitated upon the negative pole.

Nitric acid, under the same conditions, equally attacks the gold, and becomes filled with a violaceous precipitate (gold or aurous oxide?), which remains in suspension.

Dilute phosphoric acid, on the contrary, does not appreciably attack gold, even under the influence of the galvanic current; nor has potass any greater action. That gold is attacked by sulphuric and nitric acids is not due to ozone; for oxygen charged with ozone remains without action upon gold in the presence of water, whether pure or charged with sulphuric or nitric acid.

Nor does persulphuric acid (prepared by electrolysis) attack gold, even if it contains in addition a portion of oxygenated water.

It follows from these observations that the attacking of gold takes place solely from influence of the galvanic current, and at the contact of the electrode with the electrolysed liquid.

THE PHILOSOPHICAL MAGAZINE for December contains a very interesting and somewhat lengthy paper on "Magneto-Electric induction," by Frederick Guthrie and C. V. Boys, Assoc. Royal School of Mines.

GLASS-COVERED WIRE.—A patent was taken out in America, on June 20th of this year, for a system of coating wires or cables with vitreous material. It consists in inserting a lining of glass in a trough of sheet-iron or other metal, then laying the wires on the said lining, next inserting a top layer of glass, and finally consolidating the whole by heat or pressure, or both. Another patent, dated May 29, relates to drawing either the wires or vitreous mass away while the other remains stationary, also in passing the said wires finally through a suitably shaped die.

MR. BRUSH, in an article on the Brush machine in Van Nostrand's *Engineering Magazine*, makes, in conclusion, the following remarks: "Quite contradictory to the spirit of those portions of Mr. Schwendler's report, he (Mr. Schwendler) says in another place: 'If more than one light is produced in the same circuit by the same current, the external or available light becomes rapidly dearer with increase of the number of lights produced. For this reason already, if not for many others, the *division of light* must result in an engineering failure.' It seems scarcely possible that Mr. Schwendler could have overlooked the obvious fact that a current representing a given amount of energy, and adapted to produce the maximum light from one centre, may, by having its dimensions suitably altered, *i.e.*, its electro-motive force increased, and its volume diminished while its energy remains the same, be adapted to produce its maximum light from several small centres, instead of from one large one (provided, of course, the energy at each centre is not reduced below the "certain point" before defined). Yet he seems to have overlooked, or entirely ignored, this fact.

"The performance of the No. 7 Brush machine, with its 16 lamps, already detailed, proves unquestionably that the division of a large current energy among many lights in the same circuit, or, more properly, the *multiplication* of lights on a single circuit has resulted in a great engineering *success*. The votaries of the single-light system would advocate, in place of the single No. 7 Brush machine, the use of *sixteen* small machines, with their costly system of conductors. *Each* of these would require as much attendance, and involve as much expense for repairs, as the single large machine. At least 50 per cent., and probably about 100 per cent. more driving power would be required to produce sixteen lights of the same size, and the first cost of the apparatus would be vastly greater. Further, if the lights were required at any considerable distance from the source of power the single-light system must prove *entirely* impracticable."

ELECTRICITY AND PLANTS.—In a recent paper on the electric phenomena in Dionæa and other irritable plants, Professor Kunkel does not admit the existence of any electrical tension in the intact tissues of these plants, but he concludes that the currents developed upon spontaneous movements, and similarly upon artificial curvature, are due to movements of the liquid in the cells, caused by mere contact with the electrodes, or by either active or passive movements of the organs.

A NEW light company has started a subscription in Paris for £80,000. The system to be adopted is light by incandescence, the electricity being generated by an improved form of Bunsen battery.

MR. GLADSTONE'S SPEECH BY TELEPHONE.—On Saturday, November 29th, Mr. Gladstone addressed an audience in the Corn Exchange, Edinburgh; but as the enormous room was insufficient to hold the audience who flocked to hear the great orator, telephonic communication was established with the Oddfellows' Hall, a quarter of a mile distant. In describing the arrangement the *Daily News* correspondent says: "The audience distinctly heard the cheering and singing of the meeting in the Corn Exchange, and also heard the strains of the band. Lord Rosebery's voice was also recognised, and it was gathered that he was saying pleasant things about Mr. Gladstone. Next came a burst of cheering, the sound of which was suddenly stopped, and a long interval of silence followed, varied from time to time by the murmur of distant cheers. Then, as suddenly as silence had fallen, there came the sound of Mr. Gladstone's voice, and he was followed pretty well through 'some remarks on corn averages and the condition of India.' All this, which greatly mystified the telephonic audience, is capable of easy explanation. Observers of Mr. Gladstone's manners in the House of Commons will remember what an important part the right honourable gentleman's hat plays in his great speeches. He invariably places it on the table a little to one side of him, and on the top of it he places his notes, which he rapidly shuffles and rearranges as the oration progresses. This afternoon, bringing his hat to the table in his accustomed manner, he unconsciously planted it right in front of the cylinder of the telephone which had been fixed on the table, thus, of course, cutting off the means of communication. As the speech proceeded he began the rearrangement of the papers, and the movement of the hat, which latter he finally drew away from the telephone, and then became audible in another building a quarter of a mile off, 'some remarks on corn averages and the condition of India.'"

THE PASSIVITY OF IRON.—M. Louis Vareime, who has lately studied the phenomena of the passivity of iron when placed in nitric acid, as, for instance, in the Callan battery, concludes that the passivity is due to a film of nitric peroxide which collects on the surface of the iron, and thus protects it from further action. It is stated that this film can be observed by examination with the microscope.

CLARK'S STANDARD CELL.—The well-known zinc-mercury standard cell of Mr. Latimer Clark has been tested by M. Pellat, who finds that its electro-motive force is not so constant as is generally considered to be the case. M. Pellat's method of proving this result is to join up two similar cells in opposition and to observe if any difference of potential exists by means of an electrometer. It is stated that a difference equal to '01 of a Daniell cell has been found to exist between two cells apparently in all respects alike.

THE CAPE CABLE.—The Telegraph Construction and Maintenance Company's ships *Scotia* and *Kangaroo*

commenced laying a further section of the Cape Cable on December 4th. The *Seine* with the Australian Duplicate Cable arrived at Aden on the 8th.

MANUFACTURE OF CAST-IRON MAGNETS.—M. Carré publishes some details of a process he has just patented for manufacturing magnets in cast iron. He melts soft metal, very slightly carburetted in crucibles, and runs it into moulds, adding from 10 to 15 per cent. of steel filings, according to the degree of carburation, to improve its quality. Good results are also obtained by adding to the iron, when melted in the crucible, from 1 to 1·5 per cent. of nickel and 25 to 30-thousandths of copper, or 2 per cent. of tin and 50-thousandths of copper. The addition of the copper and tin to the iron facilitates tempering it at a comparatively low (cherry-red) heat. The quantities of the added metals, especially of the tin, can be reduced without detriment to the quality of the result by tempering at a higher temperature as their proportion is decreased. The best result of all is obtained by tempering pure cast iron at as high a temperature as can possibly be attained, short of reaching a degree of heat which would misshape the moulded pieces, or expose them to the liability of fracture.

THE NICKEL PLATING COMPANY. — At their Birkampton Lane Works, Stockton-on-Tees, this firm has just taken some considerable contracts for nickel-plating the engine and ship fittings for Her Majesty's steamers. The company do very large quantities of this class of work by a special and patented process.—*Iron.*

THE LEEDS CHAMBER OF COMMERCE has appointed a committee to consider the charges made in England and America with regard to patents. It was stated that, whereas in England the cost of a patent amounted in the long run to nearly £200, the expense in America was only £12.

IT is rumoured that the Postal Telegraph authorities have laid "an information" against "The Edison Telephone Company" of London, for infringement of their Act of Parliament. It is also stated the infringement is by reason of the company having accepted collect messages.

DR. DE LA RUE has now in progress a battery of 11,000 cells similar in kind to that with which he experimented recently. It is expected that it cannot be finished before the spring of next year.

ON Friday, the 5th inst., the first part of the sale of the stock, plant, and instruments, &c., of the British Telegraph Manufactory (Limited), took place at the rooms of the auctioneer, Mr. J. C. Stevens, No. 38, King Street, Covent Garden. There was a good attendance of manufacturers, but the prices generally ruled low, in some cases remarkably so. Lot 42.—A forty-dial tablet, in mahogany case, sold for 11s. Lot 43.—A thirty-dial tablet, in mahogany case, 12s. Lot 69.—A seven-dial counter, in brass case, to count 10,000,000, and model wheel and magnet for same, on mahogany stand, was knocked down for 55s. Lot 88.—A magneto bell-pull, on mahogany show stand, and rotary clock-bell alarum, an exceedingly pretty little instrument, was sold for 14s. Lot 108.—A large size Wheatstone magneto-electric motor clock, for driving fifty or sixty sympathetic clocks, in mahogany case, ran up to the small sum of only 95s. No. 109, ditto, in teak case, 150s. Amongst the Gramme machines we may mention lot 136, small hand machine, with four magnets, £5 10s. Lot 137.—Ditto, £6 10s. Lot 138.—Ditto, with two compound horseshoe magnets, £7 10s. Lot 141.—Small steam Gramme light machine, without bobbin, £2. This, probably, a year or two ago would have been taken in stock at upwards of £90. Lot 144.—A large light machine, gives light equal to 6,000 candles, stated to require 4½ horse-power to drive it, fetched 46 guineas. This was the machine reported on by Professor Tyndall, and mentioned in *Engineering* about two years ago. In the telegraph department we may mention a Wheatstone A B C indicator and switch, 11s.; two coils for duplexing Wheatstone A B C instruments, 8s.; eleven single-needle instrument dials, with magnets and coil, complete, 50s. the lot. The second portion of the stock will be sold at the same place on Thursday, the 18th inst.

TRANSPARENCY OF METALS.—With the aid of electricity, films of several metals of such minute thickness as to allow light to pass through them can be produced. An electric current is passed into a wire of one of the metals that extends to a glass tube containing rarefied air or gases. The particles of metal that the electric current loosens from the wire are deposited on the sides of the tube and form a transparent film. The light that passes through gold was a very handsome green; silver produced blue; copper, light green; platina, bluish grey; zinc, dark bluish grey; and iron, brown. —*Chemiker Zeitung.*

MR. ANDERSON'S long promised work on "Lightning Conductors" will be issued in a few days. Messrs. Spon & Co., of Charing Cross, are the publishers. We believe this work will prove an able and exhaustive treatise on the subject.

Proceedings of Societies.

THE SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting of this society, held December 10th, Lt.-Col. BATEMAN-CHAMPAIN, R.E., (President), in the chair, the minutes of the last general meeting having been read and confirmed, the Annual Report of the Society was read by the Secretary.

The report stated that 7 foreign members, 8 members, 43 associates, and 1 student had been added to the society, making a total of 4 honorary members, 157 foreign members, 329 members, 506 associates, and 13 students, or a total of 1,019.

The recent losses experienced by the society through the deaths of Sir William Fothergill-Cooke, Professor Clerk-Maxwell, and Mr. R. S. Brough were alluded to, and regret expressed. The recent conference held in London was next referred to; its object was the revision of the regulations drawn up at the last conference held at St. Petersburg in 1875. The conference commenced June 10th and lasted to July 28th. The new regulations drawn up were to be in force on and after April 1st, 1880; the most noticeable feature being the charging of messages at per word. The entertainments given to the delegates were then mentioned, and it was explained that the collection of instruments exhibited at South Kensington on the occasion of the visit of the delegates to that place was intended to have been international, but in consequence of short notice it was impossible to arrange for foreign apparatus to be brought over and exhibited. The arrangement of the apparatus was under the management of Professor Hughes and Mr. A. Stroh. The contributions to the

conference fund, as stated at the last meeting, were very satisfactory, and the disposal of the surplus for the binding of the Ronald's library was again alluded to. A list of the papers read before the society during the year was then given, and Col. Bolton's paper on "The Electric Light" was pointed out as being a particularly valuable contribution. The committee on "Wire Guages," it was stated, had agreed upon their report, and the latter would before long be issued; it was undertaken at the request of the Board of Trade. The committee on "Lightning Conductors," it was stated, would also shortly issue their report. The Ronald's library catalogue was well in hand, and 400 pages of it had already been set up in type, and of these 260, up to the letter M, were printed ready for use. It was stated that the subscriptions for the same were hardly as satisfactory as could be wished. The catalogue would contain references to 12,000 books and pamphlets. The binding of the books was being rapidly proceeded with, and 300 were already completed; the whole number would be ready next session. As one condition of the library being held by the society was that an application should be made for the incorporation of the society by Royal charter, it was satisfactory to know that active steps had been taken for this being done. The handsome gift of Dr. C. W. Siemens of £10,000 towards the erection of a suitable building for the several scientific societies which met in the building and elsewhere was mentioned. A committee to further the object had been appointed. The courtesy of the Institute of Civil Engineers in allowing the use of their lecture hall for the meetings of the society was pointed out. Some discussions having been raised with reference to the widening of the scope of the society, it was stated that the question had been taken into consideration, and an addition to the title of the society would probably be made. It was suggested that special evenings for purely electrical papers might be arranged for. In concluding the report it was stated that a large portion of the debts of the society had been wiped off, but that a large number of subscriptions were in arrear, otherwise the whole debt would be cancelled.

The adoption of the report was proposed by Col. CROSSMAN and seconded by Mr. R. GRAY and carried.

Sir CHARLES BRIGHT next proposed a vote of thanks to the Institution of Civil Engineers for their courtesy in allowing the meeting of the society to take place in their hall. This was seconded by Professor HUGHES, and carried unanimously.

A paper, by Mr. E. MARCH WEBB, on "Operations connected with the laying of the new Marseilles-Algiers cable," was then read by the author.

In June, 1871, the India Rubber, Gutta-Percha, and Telegraph Works Company laid a cable between Marseilles and Algiers for the French Government, under the superintendence of Mr. F. C. Webb, Sir Samuel Canning, Mr. Herbert Taylor, and M. Ailhaud, engineer to the French Government. This cable weighs 1¼ ton per knot for the deep sea portion, and 4½ tons per knot for the shore ends. The traffic over the line having greatly increased, the French Government found that another cable was necessary, and this was contracted for by the India Rubber Company, the specification stating that the conductor-resistance was not to exceed 12 ohms per knot, the inductive capacity not to exceed ·4 microfarads per knot, and the insulation resistance not to be less than 200 megohms per knot at 75° F. The weight of the conductor was specified at 106 lbs. per knot, and of the gutta-percha dielectric, which was to be laid on in three coatings, 139 lbs. per knot. The serving of the deep sea portion consists of 15 No. 13 galvanised iron wires; the weight of the manufactured cable was 1·50 tons, and the breaking strain 5½ tons. The intermediate cables were served with ten No. 6 wires; the breaking strain of the whole being 6 tons, and the weight 3·16 tons. The shore end is served with 10 No. 0 wires; the weight of the complete cable being 10 tons, and the breaking strain 15 tons. The deep sea portion is covered with a serving of tarred tape. The galvanising of the iron wires was to stand a test of four dippings in a solution of sulphate of copper, consisting of one pound of sulphate of copper to five gallons of water.

The steamship *Dacia*, which laid the cable, was provided with engines of 170 horse-power, and was fitted with four main tanks for the cable, and five smaller ones for grapnel ropes, spare pieces of cable, &c. There are two decks, which was a very convenient arrangement, as jointing and splicing operations could be made always under cover. The dynamometer of the paying-out machinery was of the ordinary vertical type. The paying-out drum was fitted with engine power for hauling in when necessary, and was fitted with a powerful break. The picking-up gear was worked by a pair of 50 horse-power engines. The *Dacia* was, in the first instance, fitted up by Sir Charles Bright.

On the 15th September the shore end of the cable was landed at Algiers. This was done by having two large pulleys firmly anchored on the shore at some distance apart, a hawser being passed from the hauling machine on the ship round the two pulleys, and then attached to the cable. The ship being anchored, the hauling machinery was set running, and the end of the cable thus pulled on shore. A reference was made to a method adopted in landing a cable on the coast of Chili by means of locomotives, which, in the case in question, ran on a railway close to the sea shore. The cable was lashed to a number of barrels,* which were cut loose when the end was on shore, and the cable commenced to be paid out; this enabled the whole length to be drawn straight and submerged without kinks. The use of barrels was preferable to boats, which were liable to be—and, in a case mentioned, were actually—upset in a heavy surf. The length of the shore end is 6·94 knots, and the intermediate cable 2·94 knots; the latter was submerged in 600 fathoms of water.

The electric light was used on board the ship with the greatest possible advantage and success; two Gramme machines were used, driven by 5 horse-power each. The Serrin and also the Silvertown hand regulator lamps were used. The Thomson sounding apparatus was next described, and several novel points and additions made in it explained.

The shore end at Algiers being laid, the ship steamed to Marseilles, taking 93 soundings on the way. These soundings were taken in the deepest water in from 20 to 30 minutes—10 to 11 soundings, each 10 to 11 miles distant, were taken every 24 hours. Specimens of the ooze in each case were brought up, and these were collected by Mr. Preece, who was on board the vessel. The deepest soundings were 1,500 fathoms. The French Government telegraph ship *Charente*, which assisted in the operations, was spoken of as being particularly well fitted with the necessary appliances.

On September 28th the shore end of the cable was landed at Marseilles. This was a work of great difficulty as the end of the cable had to be laid up a small stream to the cable hut, a distance of about a quarter of a mile, a low bridge having to be passed under on the way. Three boats were used for the purpose. At Marseilles 9·04 miles of shore end were laid, and 5·02 of intermediate cable.

On September 29th the laying of the deep sea portion was commenced towards Algiers. The "holding

* A full illustrated description of this method of landing cables was given in the number of the JOURNAL for May 15th, 1877.

back" gear used in paying out, which was of very simple construction, was explained.

Mr. WEBB then mentioned that owing to representations by the Postal Telegraph Department of the Post Office, the Board of Trade had issued some important regulations with reference to signals to be carried by telegraph vessels. Three red lights in place of the ordinary white light being used by night, and three balls, 2 feet in diameter, hoisted at the foremast by day; those signals indicating that the ship was not under control. These regulations were to come into force on September 1st, 1880.

The clockwork testing arrangements in use in the testing hut during the paying out were next explained.

On October 2nd the buoyed end of the intermediate cable was reached, and in hauling the latter on board the chain holding it gave way, and the end was lost and had to be grappled for; in doing this, owing to the rocks on the bottom, great difficulty was experienced, and finally in completing the operation about one-third of the intermediate cable was lost. The old cable which was broken was grappled for by the *Charente*, and repaired October 11th. The old cable when raised to the surface was found to be in perfect condition, the galvanising of the protecting wires being quite bright.

In conclusion, Mr. WEBB expressed his obligation to the India Rubber Company, for the use of the various plans exhibited.

In the discussion which followed the reading of this most interesting and well-written paper—

COL. CROSSMAN said that, being on board the *Dacia* as a guest, he could testify to the admirable way in which the whole operations were conducted, and to the skill of the engineers carrying out the work. He spoke in high terms of the value of the electric light, and of the sounding apparatus employed.

Mr. F. C. WEBB drew attention to the ingenious automatic balancing weight attached to the sounding drum. In referring to the "holding back" gear, he pointed out that it replaced the old jockey-wheel apparatus previously employed, in which as many as seven wheels had been employed on board the *Great Eastern*. A clock testing arrangement, he stated, had been employed by him when laying the Hague cable. The arrangement being, that the clock put a current on the cable for a quarter of an hour, then insulated the cable for a quarter of an hour, and finally put it to earth for a quarter of an hour. A clock arrangement was also used in the laying of the old Red Sea cable, and on the Persian Gulf cable Messrs. Latimer Clark and Laws used a clock in connection with a condenser.

SIR CHARLES BRIGHT stated that the "holding back" gear used on board the *Dacia* was designed by him, and manufactured for the first time in 1871, at Jamaica. This gear was far preferable to the jockey-pulleys working in V wheels, as the compound on the cable was liable to stick in the latter. The *Dacia* was built at Sunderland, in 1869, and was afterwards lengthened under his direction. The tanks were built at Sunderland; the engines were built by Messrs. Easton and Anderson. The whole machinery, he stated, was the best yet designed. The clock testing apparatus was used by Henley, in 1860. In conclusion, SIR CHARLES congratulated Mr. R. Gray and Mr. Webb upon the work they had so ably carried out.

Mr. F. C. WEBB stated in reply to SIR CHARLES BRIGHT that the "holding back" gear was in reality designed by Mr. Matthew Gray.

Mr. PREECE said that in his opinion the landing of shore ends by barrels was not always the best method to be adopted, and that other methods were equally as good. He spoke strongly of the value of the electric light on the ship.

The importance of numerous soundings being taken on the proposed route of the cable he insisted very strongly upon. He had urged this necessity since 1860. In his opinion no cable had been yet laid which had had sufficient soundings taken for it. He then drew attention to the form of sounding weight employed, which had a butterfly valve at the base which enabled the ooze at the bottom of the sea to be brought to the surface. Samples of these would be brought before the Society if the examination of them proved that sufficient interest was attached to them.

In conclusion, Mr. PREECE proposed a vote of thanks to Mr. WEBB for his interesting paper, which was seconded by Mr. WILLOUGHBY SMITH.

The result of the ballot for the council for the ensuing year was then announced, the result being as follows:—

President—W. H. Preece, M.I.C.E. *Past Presidents*—Lieut.-Colonel J. U. Bateman-Champain, R.E.; Charles William Siemens, F.R.S., D.C.L.; Prof. Abel, C.B., F.R.S.; C. V. Walker, F.R.S.; Latimer Clark, C.E.; Sir William Thomson, F.R.S., LL.D.; Frank Ives Scudamore, C.B. *Vice Presidents*—Prof. G. C. Foster, F.R.S.; Carl Siemens, M.I.C.E.; Major C. E. Webber, R.E.; Willoughby Smith. *Hon. Treasurer*—Edward Graves. *Hon. Secretary*—Lieut.-Col. Frank Bolton. *Council* (Members remaining in office)—Prof. W. G. Adams, F.R.S.; W. A. Andrews; William T. Ansell; Sir Charles Bright; H. G. Erichsen; Colonel Glover, R.E.; Charles Hockin, M.A., C.E.; Louis Loeffler; C. E. Spagnoletti, M.I.C.E. *New Members*—Prof. D. E. Hughes; Augustus Stroh; C. F. Varley, F.R.S. *Associate Members of Council*—Alexander J. S. Adams; Captain Macgregor Greer, R.E.; J. T. Hill.

The meeting was then adjourned till Jan. 28th, 1880.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the second meeting of the Session, held on the 18th of November, Mr. W. H. BARLOW, F.R.S., Vice-President, in the chair, the paper read was on "Tunnel Outlets from Storage Reservoirs," by Mr. C. J. WOOD, M. Inst. C.E.

The subject was divided into the consideration of culverts in a direct line through an embankment, and tunnels round the end of the embankment as a distinct work. The author stated that the practice of laying pipes through an embankment, governed by valves at the foot of the outer slope, was reprehensible, and had been abandoned for a culvert of masonry or brickwork, in which the supply pipes were laid. This method was not satisfactory, because of the settlement of the earthwork, and the subsidence of the puddle. In crossing the puddle trench, a stone or brickwork pillar had sometimes been used to remedy this difficulty with partial success, and in other cases, a "slip joint" had been made of the portion of the culvert crossing the trench, to allow a slight vertical movement. The advantages of a culvert through the embankment were speed, economy, and the building of the culvert in daylight; the author believed it best to drive a tunnel round or under the end of the embankment in the solid rock as a separate work, the tunnel to be lined with stone, brick, or cast-iron segments backed with concrete. The expense was in favour of the culvert directly through the embankment. The draw-off valves are now frequently at the bottom of a valve-pit built on the inside of the puddle trench in the embankment; they are sometimes placed at the foot of the inner slope; it had a sloping face, and was worked by rods up the inside slope. A culvert terminating in a

valve-tower of masonry or iron was the best plan, the valves being in duplicate, one set inside, the other outside, the tower. The author advocated the tunnel clear of the embankment and valve-tower as the best and safest, if more costly, plan.

Some remarks followed on the works for the supply of water to Bradford, Yorkshire, which was obtained from three districts, viz., Oxenhope, Manywell Springs, and the Skipton district. The Stubden Reservoir had been abandoned in favour of a tunnel lined with cast-iron plates backed with concrete, terminating in a cast-iron valve-tower, erected from the design and under the superintendance of Mr. A. R. Binnie, M. Inst. C.E. This was to mend a leakage which had taken place.

The Leeming Compensation Reservoir for mill owners had been seriously fractured by the subsidence of the bank, which was mostly on a clay foundation, and it was considered unsafe to fill the reservoir. On the suggestion of Mr. Rawlinson, C.B., M. Inst. C.E., and of Mr. Binnie, on the latter taking charge of the Bradford Corporation Waterworks, the old culvert was abandoned, and a new tunnel was substituted, similar to the one at Stubden. The original culvert was afterwards filled on the inside with concrete.

In the case of the Leeshaw Reservoir, which was in course of construction, on Mr. Rawlinson's inspection, it was resolved to abandon the culvert already cracked, and to substitute a tunnel outlet and valve-tower of cast iron, similar to those at Leeming and Stubden; this had been successfully done, the reservoir filled, and the work had since proved most satisfactory. In two of the above cases the culverts were so damaged as to be a strong argument in favour of tunnel outlets distinct from the embankment.

The remainder of the paper explained the form and construction of the type of cast-iron tunnel outlet and valve-tower used in these works. These valve-towers had proved successful wherever erected. Mr. Binnie was the engineer for carrying out the works, the author being the resident engineer.

AT the fourth meeting of the Session, held on the 2nd of December, Mr. BATEMAN, F.R.S., President, in the chair, the paper read was on "The Passenger Steamers of the Thames, the Mersey, and the Clyde," by Mr. W. CARSON, M. Inst. C.E.

It was stated that the bulk of the traffic by light-draught passenger steamers in Great Britain was carried on these rivers, and that each port had adopted a practice independent of the experience of the others. On the Thames above-bridge, small vessels of light draught, moderate speed, great steerage power, and well under engine control, were used, but at the expense of strength of build. On the Thames below-bridge, high speed and large carrying power led to the employment of long vessels. At Liverpool, the vessels were of heavier build, short length in proportion to beam, and great steerage power. On the Clyde the traffic somewhat resembled that of the lower Thames, but the river was more sluggish and there was less competition by land. Under these circumstances the vessels were superior in passenger accommodation, in power, and in the steering arrangements.

Some of the latest examples of the vessels employed in these three river-services were then described. The chief peculiarity of the ferry boats of the Mersey was that they had the bow and stern alike, with a rudder at each end.

It was next observed that river craft being engaged within smooth or partially smooth water limits, need not be so strongly built as sea-going vessels. The severest strains to river craft probably arose from their engine power, from the concentration of heavy machinery in the centres of the vessels, and from the weights of the fine ends which did not provide displacement to carry themselves. In considering their ultimate strength, it was pointed out that, from the long and stormy voyages which many river steamers had performed—work so far beyond that for which they had been designed—their perfect sea-worthiness for their proper duty was beyond question. From collision alone need danger be apprehended, and its results anticipated in their design. The precautions against this latter danger were stated to be: (1) effective division by bulkheads; (2) defence, especially for cross-river traffic, by overhanging sponsons; (3) perfect engine and steerage control. The steering ought to be performed by steam or water power in the larger vessels, with telegraphic communication in every case between the bridge and the engine-room. It was further suggested that an effective bulkhead division ought to be compulsory, and it would not be unreasonable to require that all seats should be fitted loose, and made buoyant, on vessels which carried so great an amount of human life in proportion to their tonnage as to render any adequate provision of boats impossible.

Review.

Electro-Plating. A Practical Handbook, including the Practice of Electrotyping. By J. W. URQUHART, C.E. London: Crosby, Lockwood & Co.

THE literature dealing with the subject of electro-plating and the processes allied to it is by no means so abundant but that there is ample room for the class of book written by Mr. Urquhart. Working directions on the art applicable to amateurs as well as professionals are much wanted, and the book in question goes a long way towards supplying this want. In a book of 200 pages, well printed and illustrated, Mr. Urquhart has certainly given a large amount of thoroughly practical information.

It is somewhat unfortunate that the author on the first page should have stated that "a current of electricity tends to decompose a metallic solution into *water* (the italic are ours) and a metal," as such a statement, coming so early in the work, tends to shake one's confidence in the author's knowledge of chemistry, a knowledge which we should think is highly necessary in dealing with the subject of electro-plating. On reading further on, however, this bad impression wears off, and we see that the author is at home in dealing with his subject.

The preparation of articles, the author points out, is a very essential point to be attended to, as dirty surfaces are the principal cause of failures.

In speaking of batteries, the Daniell, which we should think would be as good a form as any for electro-plating, is stated as giving too much trouble for rough work, though it is recommended for fine work, such as continuous gilding, that is, gilding wires drawn regularly through the solution. The Fuller's battery is spoken very highly of, but in a list giving the comparative electro-motive forces of batteries, it is put down as having an electro-motive force of 30, as compared with 100 for a Grove, and 30 for a Smee. As this table is for the use of workmen, it is decidedly misleading.

In regulating the force of the current of electricity, the usual mode is to immerse the plates of the battery more or less in the liquid. It seems somewhat strange that a simple rheostat has not been used for the purpose.

Although the book contains several slips like those pointed out, yet it is undoubtedly a useful work, and one which can be recommended.

New Patents—1879.

4708. "Improvements in, and connected with, electric bells; specially designed for signalling from the rooms of passenger ships and hotels, and for other like purposes." J. WHITE. Dated November 19.

4718. "Apparatus for holding the electrodes for use in electric lighting." W. B. GODFREY. Dated Nov. 20.

4785. "An improved electric motor." T. J. SMITH. (Communicated by H. Chameroy.) Dated November 24.

4796. "Electric lighting apparatus." T. E. GATEHOUSE. Dated November 25.

4903. "Improvements in apparatus, and in the arrangement of mechanism and parts to facilitate conversation by telephone between persons at distant places." C. E. SCRIBNER. (Partly communicated by G. D. Clark, M. G. Kellogg, and G. B. Scott.) Dated November 29.

4916. "New or improved compositions for insulating telegraph wires, cables, or other conductors of electricity." J. C. MEWBURN. (Communicated by J. Heins.) Dated December 1.

4948. "Electric signals for railways." J. J. CONKLIN. Dated December 3.

4967. "Pneumatic and electric signalling or communicating apparatus." J. and S. CLARK. Dated December 4.

4976. "Improved means and apparatus for effecting telephonic communication." J. IMRAY. (Communicated by R. G. Brown and J. F. Bailey.) Complete.

5004. "Telephones." J. IMRAY. (Communicated by J. F. Bailey.) Dated December 6. Complete.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1531. "Apparatus for telephonic and microphonic purposes." JAMES WILLIAM THOMAS CADETT. Dated April 18. 6d. Consists of a series of microphones on boards or diaphragms, with connecting or coupling arrangements, permitting of arrangements being made to suit the electric power employed, and also the resistance of the line wire, telephone, or other receiver or receivers, and so forth.

1622. "Improvements in the means employed for producing electric light." RICHARD COMINGS THOMPSON. Dated April 24 2d. Relates to the electrodes used in the production of the electric light, and consists in the employment either in a dry powdered, or in a moistened and plastic state, of the carbon or carbonaceous material or composition usually made into solid pencils or sticks of carbon for the purpose. One advantage being that the supply of the carbon may thus be made practically continuous. (*Not proceeded with.*)

2652. "Improvements in electric lamps." CHARLES WILLIAM SIEMENS. (A communication from abroad, by Friederich von Refner Alteneck of Berlin.) Dated July 1. 6d. Relates to a method of regulating electric lamps by the counteracting forces of two coils of different resistance, through one or other of which the lamp current was shunted. For this purpose the electric conductor in some part of its course to or from, or in the lamp, divides into two branches, the one leading through the coil of a solenoid or electro-magnet of high resistance, directly back to the external circuit, and the other leading through the coil of a solenoid or electro-magnet of lower resistance indirectly back to the external circuit through the carbons and the lamp. The cores of the two solenoids or the armatures of the two electro-magnets are connected by a lever to one of the carbon holders in such a manner that, when the one solenoid or electro-magnet, namely, that having the coil of high resistance, is excited, the movement of its core or armature causes the carbons to approach towards each other, and when the other solenoid or electro-magnet, namely, that having the coil of low resistance, is excited, the carbons are caused to recede from one another, and thus, when both are excited, the carbons are caused to take a position dependent on the relation of the two counteracting forces operating upon them, which position, by suitable adjustments, can be determined so as to produce the desired illuminating voltaic arc. (A full description of this lamp is published on page 412 of the present number of this JOURNAL.)

3410. "Improvements in electric batteries." WM. MORGAN BROWN. (A communication from abroad, by Colonel William Fitz-Charles McCarthy.) Dated August 25. 6d. Complete. This refers to the compositions for and methods of arranging electric batteries, as well as to the mode of using such batteries for electric purposes in general, and more particularly for the production of electric light. The principle of the invention is based upon the peculiar qualities of the currents produced by different elements. It is well known that certain elements act with pushing power, that is to say, they force or push the current away from one of their poles on the conducting wire, whilst other elements have a strong tendency to attract the current from its conducting wire towards one of their poles. The object of this invention is to utilise these peculiar qualities, and the combination in one single battery of two classes of elements which exhibit in a high degree these different qualities forms an important part in this new system.

General Science.

SCANDIUM, A NEW EARTHY METAL.—L. V. Wilson announces the discovery of a new metal, to which he has given the name of Scandium. It has been separated from ytterbia, but has not yet been obtained in a state of purity. It is the oxide of a white earth, which gives no absorption bands. After ignition, it is attacked but slowly by dilute nitric acid, but more readily by hydrochloric acid. The solution of the nitrate is completely precipitated by oxalic acid.

NORWEGIUM.—This name has been given by Dr. Tellef Dahll to a newly-discovered metal, occurring in the copper-nickel and nickel-glance of Oteroeö, a small island near the town of Krageroö, Skjœrgarden, in Norway. The mineral is roasted, the product dissolved

in acid, and precipitated by sulphuretted hydrogen, and the well-washed precipitate, free from nickel, again roasted. The product then obtained is the crude oxide of Norwegium. It is next to be dissolved in aqua regia, and precipitated with the right amount of potash (in excess of the re-agent the oxide re-dissolves), whereby an emerald-green precipitate of norwegium hydrate is obtained. This has now to be reduced with carbon or hydrogen. The metal is white, pretty malleable, of the hardness of copper, melts at a low red heat, has a density of 9·44, is soluble with difficulty in hydrochloric acid, but readily so in nitric acid; the solution is blue, and when diluted, becomes green; the metal is also soluble in dilute sulphuric acid.

A PRACTICAL CALCULATING MACHINE.—The *arithmometer* or calculating machine of M. Thomas, of Colmar, was invented in 1820. Since then it has undergone many improvements at the hands of the inventor, and latterly of his son, M. Thomas de Bojano, so that it is now offered in a form which M. Sebert, in a recent report to the Paris Société d'Encouragement, pronounces to be thoroughly adapted for practical use. The machine performs all ordinary arithmetical operations, comprising the extraction of roots. Among the more important recent improvements (for details of which we must refer to the *Bulletin* of the Society just named) is the counter of the number of turns of the motor handle, and the automatic inscription of successive figures of results, in divisions and extractions of roots, and of multipliers in multiplications, relieving the mind of the operator greatly. An idea of the progress of the machine may be had from the fact that the product of the number 99,999,999 by itself, is formed by the new machine in 24 seconds; it took nearly a minute in 1851. The new machine can also go beyond the former in giving the product of the number formed of ten nines by itself, which it does in 28 seconds. The product of the number formed of eight nines by the number formed of eight fives is now obtained in 17 seconds as against about 45 seconds in 1851. Processes of addition alone are not performed much more quickly than by an expert calculator, but mental fatigue is at least saved. The machine is well adapted for complex operations, as in calculations of algebraic formulæ, for ordinary calculations relative to constructions, cubages, estimates, &c., for calculation of formulæ into which trigonometrical values enter, and here it allows of dispensing with the use of logarithms, tables of natural trigonometrical lines being used. In construction of tables of multiplication, ready reckoners, &c., the machine gives results that are truly marvellous. The popularisation of the machine has been slow, but (with removal of imperfections) has considerably improved, as the following figures show:—In the 44 years, from 1821 to 1865, only 500 machines were sold; in the 13 years, from 1865 to 1878, 1000—viz., 300 in the five years, 1865 to 1870, 400 from 1870 to 1875, and 300 from 1875 to 1878, or 100 a year. Of the latter number about three-tenths are six figure machines, six-tenths eight figure, and only one-tenth ten figure. Of 100 machines sold, 60 go abroad, and only 40 remain in France. Among other establishments in France which use the machine may be mentioned the Magasins du Louvre, the Compagnie des Petites Voitures, the Offices of the Artillery Service, Assurance and Railway Companies, the Observatory, the Ecole Polytechnique, and Creusot. It is estimated that a machine will work daily for ten years before requiring repair; and, from the nature of the component parts, repair is easy. The price is rather high, 500f. for a six-figure machine; and M. Sebert is of opinion, considering how largely the manufacture involves the easy repetition of similar pieces, that this might be organised as to supply the machines at half the present price.

SILVERING MIRRORS.—An improvement in silvering mirrors, by which excellent results are obtained, and which at the same time spares the workmen the danger of exposure to the effect of mercurial vapours, has just been accorded a prize of 2,500 francs by the French Academy. The inventor is M. Lenoir, and his procedure is substantially as follows: the glass is first silvered by means of tartaric acid and ammoniacal nitrate silver, and then exposed to the action of a weak solution of double cyanide of mercury and potassium. When the mercurial solution has spread uniformly over the surface, fine zinc dust is powdered over it, which promptly reduces the quicksilver, and permits it to form a white and brilliant silver amalgam, adhering strongly to the glass, and which is affirmed to be free from the yellowish tint of ordinary silvered glass, and not easily affected by sulphurous emanations.

THE SOLUBILITY OF SOLIDS IN GASES.—Messrs. J. B. Hannay and J. Hogarth, in a paper brought before the Royal Society, have investigated the solubility of solids in gases. The object of the investigation was to determine under what particular conditions liquids are dynamically comparable, in order that the micros-heometrical method devised by the authors might be applied to determine their molecular mass and energy relations. At a certain point, called the "critical" point, the laws relating to solids and gases become merged. To investigate the conditions beyond the critical point the authors dissolved in a liquid some solid whose fusing point was much above the critical point of the liquid, and noticed whether, on the latter passing the critical point and assuming the gaseous condition, the solid was precipitated or remained in solution. The result showed that the solid was not deposited even when the temperature was raised 130° above the critical point. Some solutions show curious reactions at the critical point. Thus ethyl, alcohol, or ether deposits fine chloride from solution just below the critical point, but redissolves it in the gas when it has been raised 8° or 10° above that temperature.

LARGE GAS-HOLDERS.—The Birmingham Corporation Gas Works, Saltley, have just had two of their gas-holders increased in capacity by "telescoping." The execution of the work has been one of great difficulty, as the existing sides of the gas-holders had to be cut clear away from the top framing, and in each case the weight of the latter, about 250 tons, has had to be supported on framing 42 ft. from the bottom of the tank in which the gas-holder works. The sides so cut away have been converted into the outer vessels, and new sides had to be constructed in the tank to form the inner vessel, to which the top had again to be connected. The capacity of each of the holders by this means has been increased from 1,100,000 to 2,200,000 cubic feet. The contractors for the work (Messrs. Ashmore and White, of Stockton-on-Tees) are about to construct an enormous holder for the South Metropolitan Gas Company to contain no less than 5,000,000 cubic feet of gas.

NAVIGATION ON THE MISSISSIPPI.—The recent improvements effected at the mouth of this river have been such that a short time ago the Inman s.s. *City of Bristol*, drawing 24 feet 7 inches of water, passed through the jetties without obstruction either at the jetties or at the head of the pass.

THE TUNNEL UNDER THE MERSEY.—On Monday, December 8th, a commencement was made of the

tunnel to be driven under the Mersey. The engineers propose to drive trial headings from both the Liverpool and Cheshire sides of the river, and when the nature of the strata is ascertained, to commence the main railway tunnel.

URALIUM, A NEW METAL.—As far back as 1869 the author discovered this metal in commercial platinum obtained from Russian ores. Next to silver it is the whitest metal known; its malleability is as great as that of the purest platinum, but its ductility is much greater, and it is almost as soft as lead. Its melting point lies near to that of platinum, and it is not volatile. Its specific gravity = 20·25, and its molecular volume, like those of osmium, platinum, and palladium, is 6·25. Its atomic weight has been found 187·25. In its chemical properties it is difficult to distinguish from platinum.—*A. Guyard.*

HEAT REGULATOR.—We were shown a few days ago, by Mr. Tisley, of the Brompton Road, a very neat form of heat regulator, designed by Mr. Williams, who is, we believe, assistant to Dr. Thudicum. It is an improvement on that invented by Mr. Page, of the London

University, and used by Professor Tyndall in his experiments on germs. It consists of a glass tube and bulb containing mercury. The tube has two branches (A and B) at the top, each connected with the gas-pipe supplying a Bunsen burner. There is also a third branch (C), up which the mercury also rises, and in which is inserted a regulating plug of wire (P). This having been adjusted to any necessary degree of sensitiveness, the bulb being placed in position, the rising of the mercury in the tube A will, by shutting off the gas supply, restrain the temperature from rising above the desired pitch.

REGISTERED STOCK.
IMPORTANT DECISION.

TO THE EDITOR OF "THE DAILY TELEGRAPH."

"Sir—The decision in the case of 'Simm and Ingelow *versus* the Anglo-American Telegraph Company,' decided in the Court of Appeal yesterday, is so important to holders of registered stocks and shares, and so subversive of the general belief hitherto entertained, that we would draw attention to the facts, which, briefly stated, are as follows:—We purchased in 1876, *bonâ fide* in open market, £5,000 Anglo-American stock, paid the money for it, and it was duly registered in our nominees' names. They received the company's certificate of registration, and subsequently three dividends upon the stock.

"Ultimately the signature of the original transferror was found to have been forged, and the Telegraph Company claimed the stock back again. The Court of Appeal, reversing the decision of Mr. Justice Lindley, uphold this claim of the company.

"Henceforward any *bonâ fide* investor in registered stock may find that a security, which upon the faith of an official certificate of ownership he has regarded as indisputable, may prove worse than waste paper.—Yours obediently, "BURGE, BROWN, and DENNIS.

"3, Austinfriars, E.C., Dec. 6."

THE liquidators of the Direct United States Cable Company (Limited), in liquidation, give notice that a first and final dividend of 3s. 8d. per share will be payable at the offices of Messrs. Deloitte, Dever, and Co., on and after Dec. 29th inst., to those members who were on the register on Aug. 8th, 1877, and who accepted shares in the Direct United States Cable Company (Limited), incorporated in 1877, in lieu of the shares held by them in the other company.

THE directors of the Brazilian Submarine Telegraph Company (Limited) have declared an interim dividend of 2s. 6d. per share, or 5 per cent. per annum, for the quarter ended Sept. 30 last.

The following are the final quotations of telegraphs for Dec. 12th:—Anglo-American, Limited, 55¾-56¼; Ditto, Preferred, 81½-82; Ditto, Deferred, 31¼-31⅝; Brazilian Submarine, Limited, 7½-7⅝; Cuba, Limited, 8¼-8⅜; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 2½-2⅝; Direct Spanish, 10 per cent. Preference, 12-12½; Direct United States Cable, Limited, 1877, 10½-10⅝; Eastern, Limited, 8⅜-8½; Eastern, 6 per cent. Debentures repayable Oct., 1883, 102-105; Eastern 5 per cent. Debentures repayable Aug., 1878, 101-104; Eastern, 6 per cent. Preference, 11⅞-12; Eastern Extension, Australasian and China, Limited, 8⅜-8½; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 101-102; Ditto, registered, repayable 1900, 101½-102½; German Union Telegraph and Trust, 8¼-8⅜; Globe Telegraph and Trust, Limited, 4¾-5¼; Globe, 6 per cent. Preference, 11-11½; Great Northern, 8¾-9; Indo-European, Limited, 22½-23½; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 9½-10¼; Reuter's Limited, 10-11; Submarine, 230-240; Submarine Scrip, 2⅛-2⅜; West Coast of America, Limited, 1-1½; West India and Panama, Limited, 1⅛-1½; Ditto, 6 per cent. First Preference, 7½-7⅝; Ditto, ditto, Second Preference, 6½-7; Western and Brazilian, Limited, 5⅝-5¾; Ditto, 6 per cent. Debentures "A," 97-100, Ditto, ditto, ditto, "B," 96-100; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 34-36; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¾-3; India Rubber Co., 12¾-13¼; Ditto, 6 per cent. Debenture, 105-107.